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AVIATION WEEK

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Northrop's Snark: Intercontinental Potential Today

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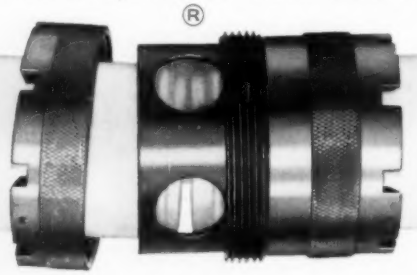

flexible union for connecting rigid tubes.

are you interested in weight reduction?

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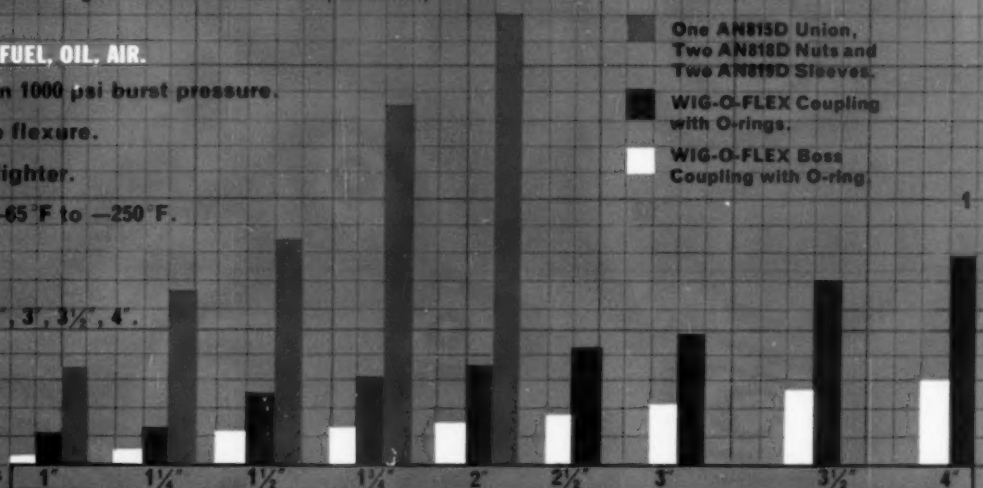

WEIGHT COMPARISON CHART

WIG-O-FLEX COUPLING & AN STANDARD FLARED TUBE CONNECTION

WRITE FOR FURTHER INFORMATION.

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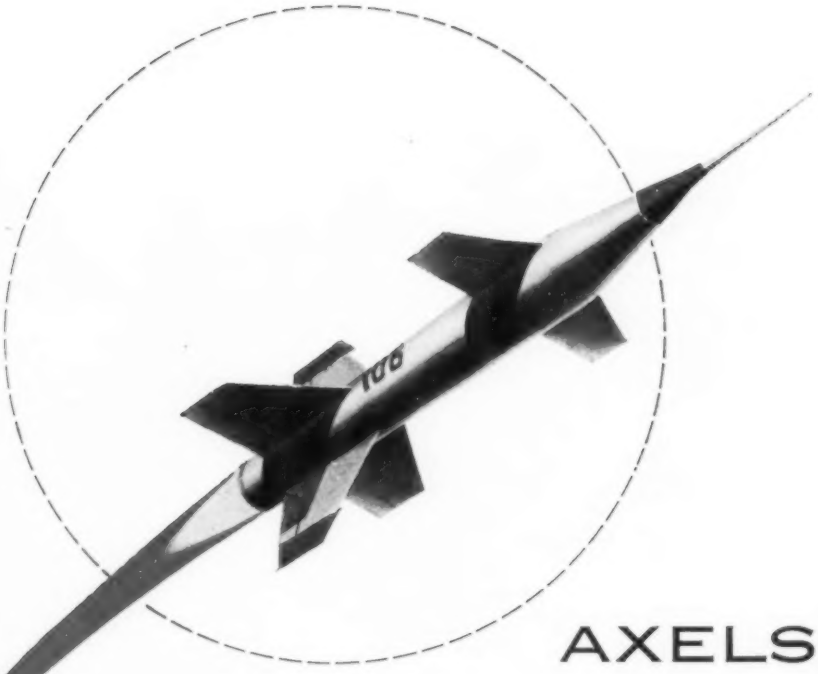

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AVIATION CALENDAR

April 2-4—American Institute of Electrical Engineers, Southwest District Meeting on "Electricity in Aircraft," Baker Hotel, Dallas, Texas.

Apr. 9-12—Society of Automotive Engineers, national aeronautic meeting, aeronautic production forum and aircraft engineering display, Hotel Statler, New York, N. Y.

Apr. 10-11—Symposium for Management on Application of Analog Computers, sponsored by Midwest Research Institute, University of Kansas City, Kansas City, Mo.

Apr. 15-19—Airport Operations Council, 9th annual conference, Hotel Warwick, Philadelphia.

Apr. 16-18—Aero Medical Association, Drake Hotel, Chicago.

Apr. 18-19—First Annual National Industrial Research Conference, sponsored by Armour Research Foundation, Hotel Sherman, Chicago.

Apr. 19-20—Annual Meeting of the Science Section of the Environment Equipment Institute, Sheraton Hotel, Chicago.

Apr. 22-26—American Association of Airport Executives, 29th annual convention, Hotel Carter, Cleveland, Ohio.

Apr. 26—Institute of Navigation, annual regional meeting, Friendship International Airport, Baltimore, Md.

Apr. 26-27—Aeronautical Training Society, annual meeting, Mayflower Hotel, Washington, D. C.

Apr. 26-27—Institute of the Aeronautical Sciences Southeastern Student Conference, Georgia Institute of Technology, Atlanta, Georgia.

Apr. 30-May 4—Society of Aeronautical Weight Engineers, 15th national conference, El Cortez Hotel, San Diego.

May 2-3—Air Traffic Conference of the Air Transport Assn., Spring Meeting, Hotel Radisson, Minneapolis, Minn.

May 2-5—Twelfth Annual National Forum of the American Helicopter Society, Sheraton-Park Hotel, Washington, D. C.

May 3-4—Sixth Annual Institute of Aeronautical Sciences, West Coast Student Conference, Los Angeles.

May 6-9—Second Annual Symposium on Flight Test Instrumentation, sponsored by Instrument Society of America, Bell Aircraft Corp., Convair and Temco Aircraft Corp., Fort Worth, Tex.

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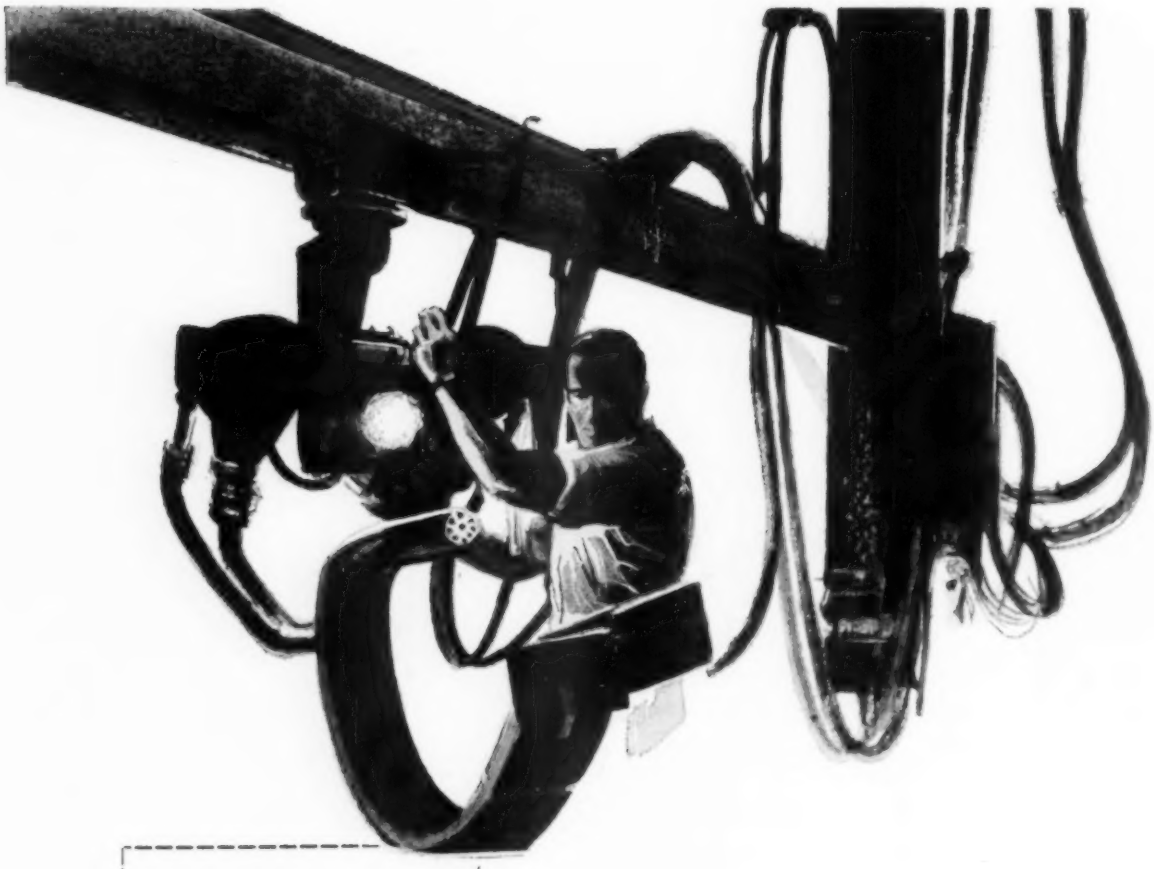

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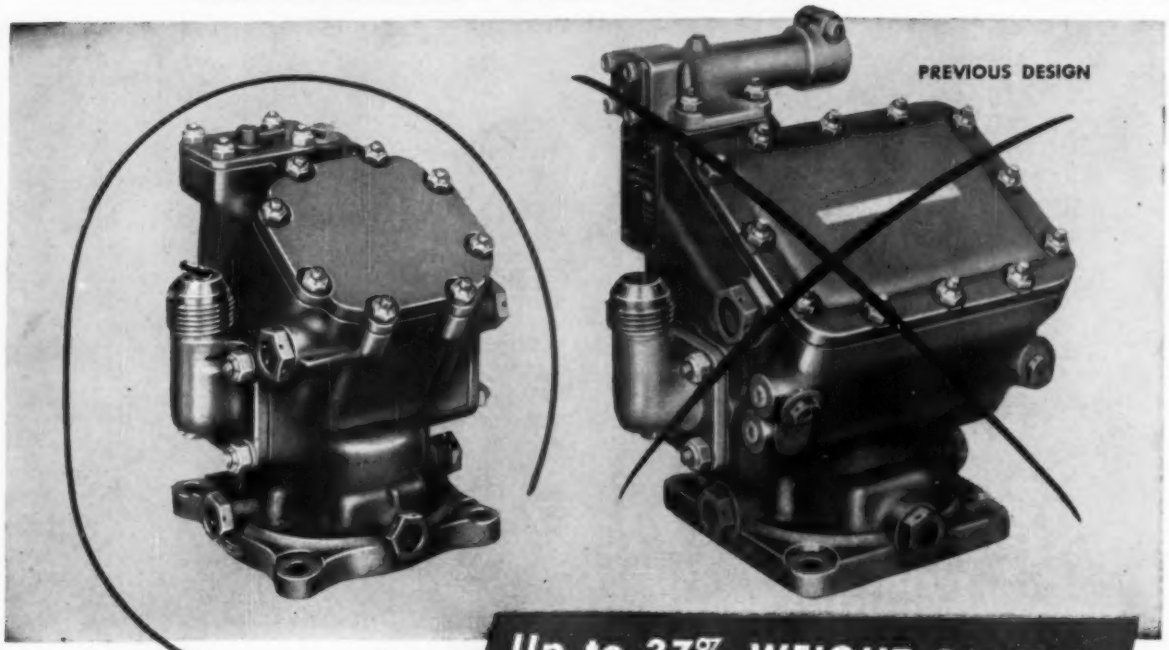

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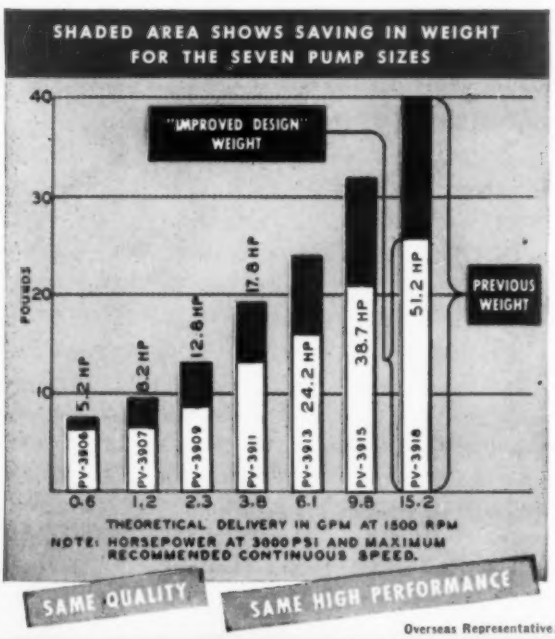

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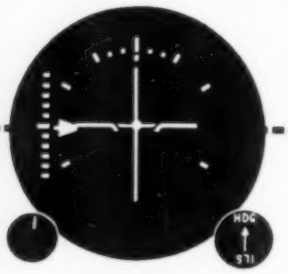

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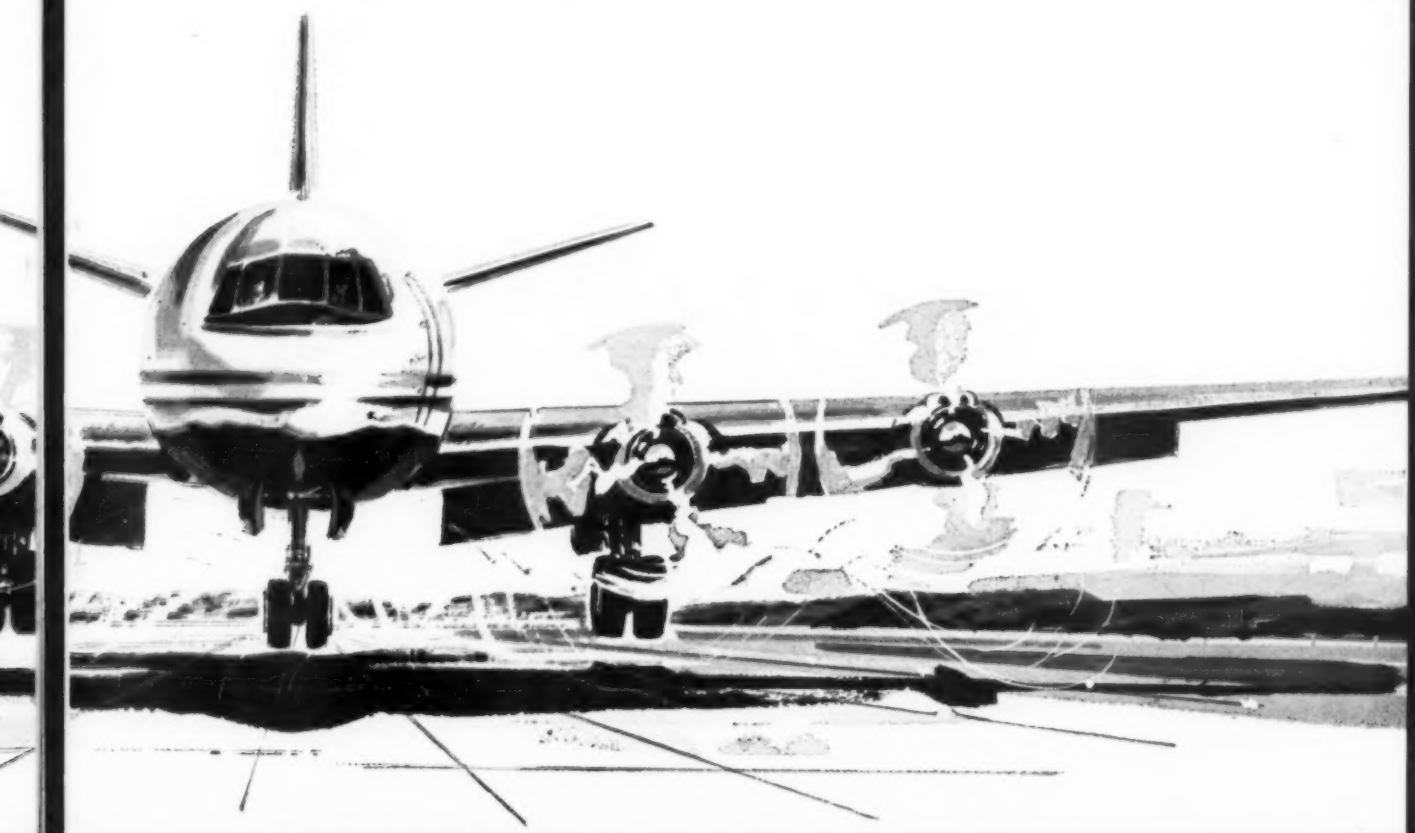

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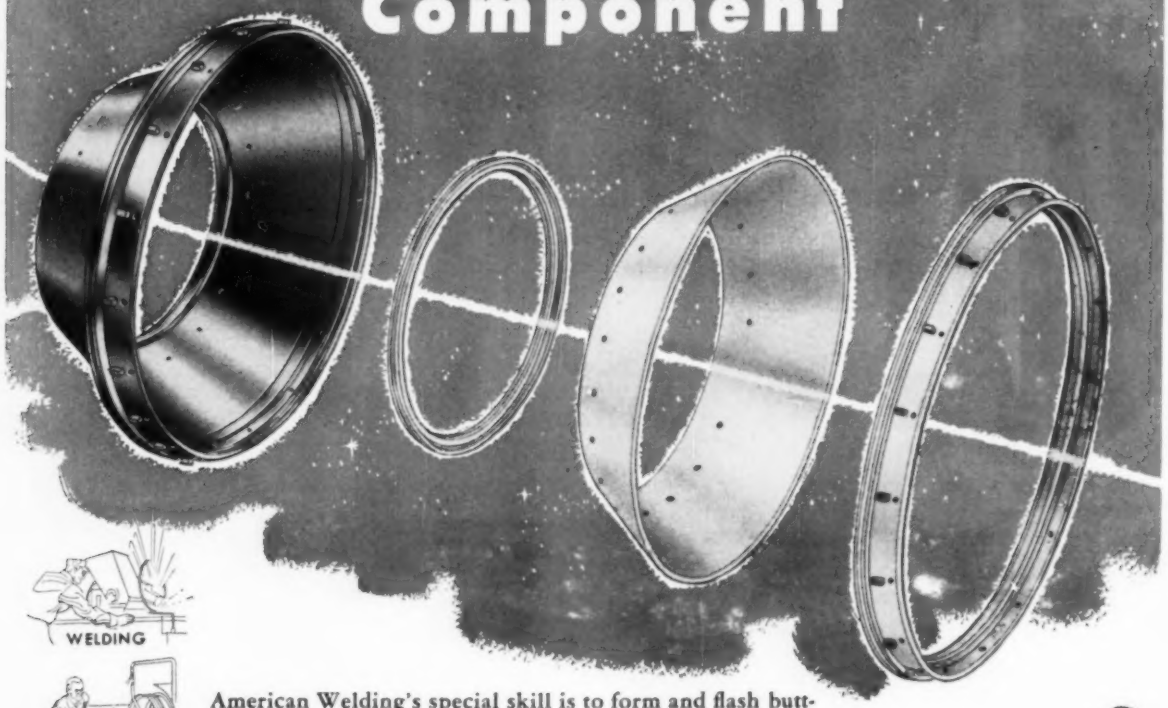

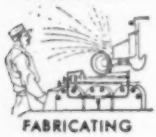

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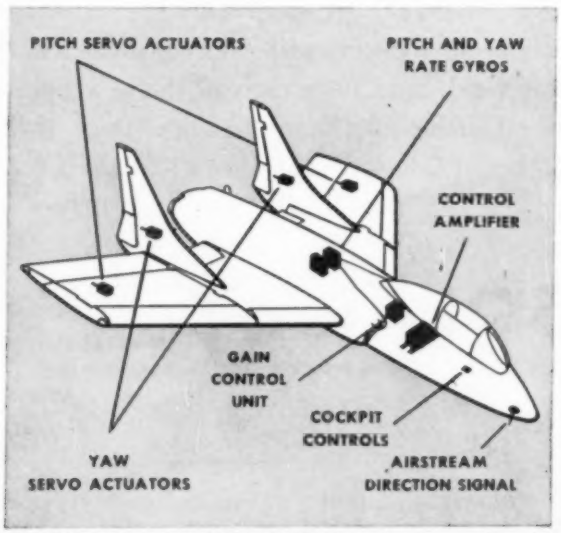
CHANCE VOUGHT F7U-3 equipped with G-E flight stabilization system catapulted from carrier. (Official Photograph U.S. Navy)

How G-E flight stabilization system makes the Cutlass a stable gun platform



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COVER: Two Northrop F-89D Scorpions sweep over snow-covered mountain range on patrol for the Alaskan Air Command. The F-89D, equipped to carry 104 rockets in its wing-tip pods, is now the USAF's standard all-weather interceptor, but it will gradually be replaced by a younger sister, the F-89H. The newer version will carry Hughes Falcon guided missiles (AW March 19, p. 32).

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EDITORIAL

Need for Air Age Education

"Our primary and secondary schools must stress aviation education if our citizens are to meet the responsibilities of world leadership." These words are as true today as when they were first written in 1948 by the bi-partisan Congressional aviation policy board of the 80th Congress. The American people must understand the basic nature and problems of airpower if they are to survive as a free nation. To produce an air-minded nation we must begin by producing an air-minded youth.

Much of the pre-war glamour has faded from aviation. From a goggle-and-helmet-pylon-racing, transatlantic-hopping era, aviation has matured into an incredibly complex technology that is the keystone of our national defense structure and a method of routine transportation that has altered the basic personal and economic habits of our people. American youth is still potentially air-minded but it needs more than the glamourous mythology of aviation's past to translate that potential into the type of air-minded citizen that is required to work in civil and military aviation and legislate intelligently a constantly changing national air policy tailored to meet the needs of this country's future.

The aircraft industry has a definite responsibility to aid the cause of air education. It is doing an increasingly better job of discharging this responsibility at the college and post graduate level through scholarships and on-the-job opportunities for advanced degrees. It also helped the national aviation education council with financial backing to begin organization of an effective program at the elementary and high school level.

To this industry backing has been added support from the non-profit National Aeronautical Association. The NAA support programmed for a three year period has enabled the National Aviation Education Council to hire a full time executive director, Dr. Evan Evans, a veteran Kansas school administrator, and begin a program to provide air educational material for pre-college level schools. The support of the aircraft industry and NAA have enabled this vital program to get off the ground and prove its initial effectiveness on the modest scale its finances permitted serving about 1,000 elementary and secondary schools in this country.

Now a much greater effort is needed to fully cover the country. The aircraft industry is being asked for further financial aid to expand the council's program. The response from educators who are already using the council's materials indicates the demand for this activity already exists.

The aircraft industry can look a long time before it will find a better cause in which to invest some of its funds. Aid to the council's air education program represents a sound investment in the future of this country and its people.

Bring Back the World Speed Record Now

Thanks to Defense Secretary Charles E. Wilson and his somnolent public relations aides the British have been able to recapture the world speed record from the United States. The achievement of the Fairey research Delta FD2 in averaging 1,132 mph. over a measured course at 38,000 ft. altitude gives sagging British aviation a much needed, if temporary, prestige stimulant.

However, this British record would not have been possible without the alleged security wraps put on the new crop of 1,000 mph. U.S. fighters. To put the British record in proper perspective it must be noted that it was set with an advanced research type aircraft while the United States has at least three fighting aircraft designed for operational service that can outrun the Fairey research plane. The Vought Crusader (F8U-1), built as a Navy carrier-based fighter, has already flown well over 1,000 mph. and can do better. The McDonnell Voodoo F-101 long-range interceptor built for USAF has also surpassed the 1,000 mph. mark by a wide margin and has further speed capability. USAF will shortly reveal one of its worst kept secrets in the Lockheed F-104, which has a capability in the 1,200 mph. range and proves its maker's long-held theory that thin straight wings can do well in the truly supersonic speed range.

The big difference is that the Crusader, Voodoo and F-104 are all fighting airplanes armed with cannon, rockets and missiles while the British record holder is an experimental research plane. In this research field the Bell X-1A hit Mach 2.5 (1,650 mph.) more than two years ago.

However, none of the new crop of USAF and Navy fighters have been permitted to perform under official FAI course and timing conditions because of an edict by Defense Secretary Wilson. Mr. Wilson is presumably informed by his public relations deputies that the Russians are unaware that we have 1,000 mph. fighters.

Now that the British have officially proved that it is possible for western aircraft to fly faster than 1,000 mph. we strongly urge Mr. Wilson to remove his senseless restriction against official U.S. speed runs and to allow the return of the world speed record to this country—where it rightfully belongs.

—Robert Hotz

The North American Super Sabre streaks for altitude at supersonic speed.

up on its tail—of TITANIUM

Most of the tail section and many other vital parts of North American's F-100C supersonic fighter are made of titanium. It not only reduces gross weight by several hundred pounds, it withstands the searing combination of engine and aerodynamic heat.

Titanium is no stranger to North American aircraft. The first F-100, FJ-4 and earlier planes like the F-86D Sabre Jet and the FJ-2 and FJ-3 Furies for the Navy all fly with titanium.

Here's why—Titanium's high strength-weight ratio . . . its freedom from stress corrosion cracking . . . its corrosion resistance . . . and its ability to withstand high operating stresses have made it an *essential* part of high-performance aircraft.

REM-CRU led in the development and production of titanium for aircraft applications. And REM-CRU's enlarged facilities mean *prompt* delivery of the titanium grades, sizes and shapes you need—including new high-strength, weldable alloys. What's more, REM-CRU is always glad to share with you the wealth of titanium data it has available.

Seam welding REM-CRU titanium tail section.

To keep abreast of the latest developments on this vital metal, write to Dept. A-3 for the Rem-Cru Review—a free periodical presenting the latest technical data on titanium alloys.

REM-CRU TITANIUM

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WHO'S WHERE

In the Front Office

Raymond A. Rugge, vice president-Research and Development Division, W. L. Maxon Corp., N. Y.

Paul E. Dixon, Jr., president, and **Victor V. Carmichael, Jr.,** vice president and re-elected a director, ASA International Airlines.

L. R. (Mike) Hackney, assistant to the president, Air Logistics Corp., Pasadena, Calif.

Herbert O. Patchel, Jr., vice president and assistant to the president, Babb Co., Inc., Phoenix, Ariz.

Clare Mason, executive vice president, Electronic Specialty Co., Los Angeles, Calif.

John A. Doremus, vice president-engineering, Aircraft Radio Corp., Boonton, N. J.

C. D. W. Thornton, assistant to the president, Farnsworth Electronics Co., Fort Wayne, Ind.

George Wunderlich, vice president-manufacturing; **E. E. McClaran,** vice president-finance; **Frank Mansur,** manager-marketing; **John S. McCullough,** director-research, and **Fred A. Speaks,** assistant director-research, Eitel-McCullough, Inc., San Bruno, Calif.

E. A. Ritti, director-engineering, Burton Rodgers-Technical Training Aids, Inc., Cincinnati, Ohio.

Rudolph Deetjen, senior partner of Emanual, Deetjen & Co., N. Y., elected a director of Piasecki Aircraft Corp.

Honors and Elections

William G. Purdy, received the Missouri Honor Award for Distinguished Service in Engineering from the University of Missouri. He is chief engineer-Denver Division, the Martin Co.

Charles P. Haskell, elected president and **Louis J. Sculley,** re-elected chairman, the National Association of Manufacturers Representatives.

Changes

Dr. Renne S. Julian, technical director-guided missile laboratories: **Charles C. LeGrand,** head-electronics department; **George McLaughlin,** assistant to LeGrand; **Thomas B. Carvey, Jr.,** assistant head-design integration department; **Robert E. Sears,** assistant head-propulsion department; **Lowell C. Parode,** assistant head-electronics department, Weapon Systems Development Laboratories, Hughes Aircraft Co., Culver City, Calif.

Arvid E. Olson, Jr., assistant to director-military relations and customer service, Northrop Aircraft, Inc., Hawthorne, Calif.

James H. Brewster, III, director-customer relations, Electronic Systems Division, Sylvania Electric Products, Inc., Waltham, Mass.

Dr. Vladimir A. Sklodowski, manager, human engineering section, Crosley Government Products Division, Avco Manufacturing Corp., Cincinnati, Ohio. Also, **Frederick W. Trabold, Jr.,** industrial psychologist and **Maurice A. Larue, Jr.,** research physicist.

INDUSTRY OBSERVER

►North American Aviation, Inc., has won the Air Force design competition for a long-range interceptor. The Northrop Aircraft, Inc., entry was designed around four 12,000-lb. thrust General Electric Co. J79 engines. Lockheed Aircraft Corp., once in the competition, already had received Air Force permission to drop out because it could not spare manpower from other projects and because production would not be immediate.

►Fifteen companies have submitted designs in response to USAF's request for a multi-jet combination transport and combat proficiency trainer. All call for four engines except Convair's, which calls for two. All are designed around either the General Electric Co.'s 2,000-lb. thrust J85, originally designated MX2273 and planned for use in drones and pilotless aircraft, or the Fairchild J83, also a 2,000-lb. thrust turbojet, probably a single-spool axial flow compressor.

►Convair Terrier, anti-aircraft guided missile, is 27 ft. long. Rocket booster takes up 14 ft. of this, accelerating weapon to Mach 2 in about four seconds before dropping off and leaving 13 ft. of missile with proximity fuse to find target. Fastest part of run is at Mach 2.5.

►Navy says Terrier, fired from the cruiser USS Boston, has intercepted target at altitude "on the order of 50,000 ft." It has knocked down a jet drone flying "faster than 500 knots" and a Regulus guided missile.

►Terrier booster rocket produces more than 200,000 horsepower. Booster is 8 inches in diameter. Both it and missile use solid propellant.

►USS Boston's radar can track two targets at a time, control eight missiles a minute in the air. Electronic brain tracks targets, picks highest-priority threat to get next shot from launcher.

►Convair's new Tartar missile, which will be used by all ships of fleet as anti-aircraft weapon, will look like Terrier, but smaller. Operating without booster, Tartar will equal or better Terrier performance.

►Cost of Terrier at present production rate is about $30,000, will drop on deliveries in next fiscal year. Tartar will cost about half of this figure. For comparison, bigger Martin Matador, used in Europe by USAF, is worth about $85,000.

►Terriers are delivered by rail from factory to depots on East and West coasts. Replenishment ships with special handling facilities deliver them to fleet at sea.

►Army's anti-tank missile, the wire-controlled Dart, has been tested against ground targets by Ordnance missile technicians. Dart is about six feet long, was designed by Aerophysics Development Corp., subsidiary of Studebaker-Packard Corp. Wire-control of missiles was pioneered by Germans in World War 2 with their X-4 air-to-air missile, test fired under operational conditions from Focke-Wulf 190 aircraft. Control motions are transmitted electrically through trailing wires from the missile to the director.

►Carrier qualification trials for Chance Vought's F8U-1 Crusader, Grumman F11F, Douglas A3D and A4D, North American's FJ-4 and an experimental plane from Naval Air Test Center at Patuxent River, Md., will be held aboard the USS Forrestal next month.

►D. Napier & Son Ltd. is negotiating for a U. S. agency for the Eland turboprop engine. Napier has developed a conversion kit for operators desiring to convert Convair 340s to the Eland engine. Installation of the 3,200-hp. Eland 1 is claimed to provide a power gain of 1,600 hp. and save 2,000 lb. The Eland 6, developing 3,500 hp., will be available soon.

►Rolls-Royce will begin testing its jet engine silencer of the Comet III soon.

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STAGE LENGTHS UP TO 1500 STATUTE MILES

The improved de Havilland Heron introduces four-engined safety into the field of executive travel without the customary high costs, yet with a practical, efficient and elegant vehicle capable of fast, long-stage journeys. Safe, easy handling qualities with the ability to use small airfields.

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Washington Roundup

Durfee to CAB?

James R. Durfee, 58, a Wisconsin Republican, has been tapped by the White House for a five-year term on the Civil Aeronautics Board. The decision was reached last week at a meeting of President Eisenhower and Durfee which was arranged by presidential aide Sherman Adams. He is expected to be named to the CAB chairmanship succeeding Ross Rizley, whose resignation has been pending since his Senate confirmation as a Federal judge for western Oklahoma. An attorney, Durfee is currently chairman of the Wisconsin State Public Utilities Commission.

Furnas Memorandum

Defense Secretary Charles E. Wilson has withdrawn his memorandum of Feb. 21 which shifted responsibility for weapons development from Dr. Clifford C. Furnas, his assistant for R&D, to Frank D. Newbury, Assistant Secretary for Applications Engineering. The reason stated in a new memo from Wilson's office: "The situation . . . requires further study." The real reason: a strong letter from Dr. Furnas demanding that his job be restored, backed by a threat of resignation (AW Mar. 5, p. 27). Wilson now says he is withdrawing his order upon the recommendation of Furnas and Newbury. Word in the Pentagon is that there has been no meeting of all three men since Feb. 21, although Wilson has talked separately with Furnas, possibly with Newbury. At least one of the three has been out of town nearly every day since the original memorandum was issued.

Security Snafu

Latest security snafu occurred at recent meeting of American Rocket Society when a paper on structural research on high heating rates with free-flight rockets was cancelled. Author obtained the usual clearance from Wright Air Development Center and Air Research and Development Command, but paper was ordered withdrawn by the Pentagon. Reason given was not that the paper contained classified information, but that it did contain some items that were not wanted in the press right now. Among the items not wanted in the press were pictures of the rocket vehicles used in the experiments. The pictures appeared in Life with that magazine's spread on the ICBM a few weeks back.

No Cartel

Sir William Hildred, Director General of International Air Transport Assn., bitterly protested the designation of IATA as "a cartel" by Irving Roth, Chief of Civil Aeronautics Board's rates divisions in testimony before the House Judiciary Subcommittee headed by Rep. Emanuel Celler (D.-N. Y.).

Sir William declared that IATA has none of these characteristics of the cartel: limited membership, no competition, a divided market, limited production, elimination of competitors, fixed prices. He conceded that in price-setting IATA might be considered as approaching the nature of a cartel, but emphasized these two points: all rates agreed to by IATA members are subject to governmental approval—which is not the case with the private cartel; and the trend of IATA is toward lower rates, while the cartel cuts out competition to maintain high rates. He reported that it is now possible to cross the Atlantic for $380, compared with $1,080 in 1945. The only alternative to rate agreements among IATA members, he said, is rate warfare.

If U. S. carriers undercut on international rates, Sir William replied to skeptical questioning by Celler, "they would find that they would not have any place to land, and would soon run out of petrol."

Bilateral Talks

The bilateral negotiations between the United States and the United Kingdom in London ended this month with major questions left unanswered. The U. S. delegation secured operating rights for Seaboard and Western Airlines, but the talks ended without agreement on Trans World Airlines' Frankfurt-Zurich route or Northwest Airlines' route to Hong Kong. The meeting was a continuation of talks started last May, and discussions probably will be resumed in Washington in June.

Some Caribbean routes were modified in the negotiations. Ft. Lauderdale and Tampa were added to the British route from the Bahamas and these two points and Havana were added to the American route. The routes were modified to allow the carriers to fly to any point in the Bahamas, rather than naming specific terminals. The negotiators also agreed that Pan American World Airways should be allowed to stop at Kano, Nigeria, on its South African route.

AMC Confusion

Facilities furnished contracting personnel at Air Materiel Command headquarters "are far from the best," but the conditions under which they work "are even worse," according to an investigation by House Appropriations Committee's staff, which said: "It is no wonder there are paperwork delays, negotiation problems, and a general bogging down of work at AMC."

This is the picture reported:

"There was inadequate space in offices. Conference tables were often located in the same room where the desks of the buying personnel were located. This lack of privacy was not good, especially when representatives of contractors were in the room. Company representatives were often in the room while Air Force business was being transacted, so Air Force personnel had to guard their conversations carefully. . . ."

The procurement people "were always making reports to generals and other officers at staff level. Supervisory personnel were often preparing for briefings and presentations of various problems. . . ."

The procurement offices "were almost as noisy and confusing as a newspaper office, just before the edition goes to press."

Postage Increase

Prospects now look the brightest ever in the Post Office Department's three-year fight to gain Congressional approval of postage increases, which includes upping the air mail rate from 6 cents to 7 cents. Welcome support has come from the airline industry. The airlines' endorsement is indicative of the changing attitude of various effected interests to the need for reducing the department's annual deficit and providing for improved mail handling and mail service.—**Washington staff**

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USAF, Navy Procurement Policies Hit

Congressional group protests 'misuse' of production funds for R&D, charges firms get unequal treatment.

By Katherine Johnsen

Washington—Two Congressional committees are pressuring the Air Force and the Navy to move fast in improving their aircraft procurement programs.

The lack of policy guidelines on cost and profit allowances—with the result that different manufacturers receive different treatment—is the basic target of criticism of both the House Armed Services Investigating Subcommittee and the Military Appropriations Subcommittee.

Highlights in developments last week were:

• **The "misuse"** of procurement funds for research and development projects, cutting back funds for aircraft production, was protested in a comprehensive staff report of the Appropriations Subcommittee. The diversion of funds, it said, possibly means that Air Materiel Command will not be able to procure the 2,333 airplanes in its Fiscal 1956 program. The early shifting of developmental projects to AMC has been supported by Lt. Gen. Thomas S. Power, chief of the Air Research and Development Command, the report said, but opposed by Lt. Gen. Donald Putt, Deputy Chief of Staff for Development.

• **USAF and Navy** will insist that aircraft manufacturers plough back more of their earnings into facilities, according to witnesses before the Army Services Subcommittee. Rep. Edward Hebert (D.-La.), chairman, proposed that companies be required "by compulsion" to invest a percentage of their earnings from government business in facilities.

He suggested that higher profits on contracts might be allowed, if this were necessary for private financing of the new facilities. Navy declined to comment on the suggestion for higher profits, but Assistant Secretary of the Air Force for Procurement Dudley Sharp said that under present profit policy the industry has achieved stability and "can now achieve the financial growth it needs if it continues its ambitious re-investment of earnings and supplements its net worth by seeking new risk capital."

• **Both services** endorsed renegotiation as a means of reviewing the overall financial position of aircraft companies and pointed out that with the services there is only a contract-by-contract review.

• **A reduction** in the amount of progress payments to finance work on aircraft contracts—now 75% of cost—was anticipated by Raymond Folger, Assistant Secretary of the Navy for Materiel. He thought, though, that a reduction to 35%, suggested by Rep. Leon Gavin (R.-Pa.), was too low.

• **Consideration will** be given to making overhead allowance on military aircraft contracts uniform by setting them at a percentage of sales or net worth, Folger disclosed. Hebert emphasized the wide discrepancies in the management salaries of different aircraft companies. It was developed that USAF disallows bonuses, for example, while the Navy allows them as costs on contracts.

Declaring that the airframe industry is "a government subsidiary" and that without military contracts it has "faltered and failed," Hebert questioned whether "the government bureaus are ineffective because they do not have big salaries commensurate with those of airframe companies? For all practicable purposes their officers are government officers."

R&D Fund Hassle

Two results of the "misuse" of production money to finance R&D projects objected to by the staff of the Appropriations Subcommittee, headed by Rep. George Mahon (D.-Tex.), were:

• **The premature** ordering of items in quantity, causing waste of funds.

• **Contractors diverting** funds to research gain a preferred position for new business.

"Under the present system, one contractor can gain considerable advantage over another by using more funds in the general research area, thus developing new types of equipment with production funds at government expense, and then obtain control of this newly developed equipment from the government," the report declared.

"The amount of general research expenditures allowed to a contractor should not be based purely on a percentage of the contracts in force. This permits the contractor with the greatest amount of contracts to obtain still further advantage over his associate and eventually become even larger with more production contracts.

The practice of proportioning general research expenses to production contracts results in production items becoming more costly and prevents the government from making a fair comparison of its production costs from the various airframe and engine manufacturers." In one instance, it was stated, 30% of production funds were being diverted to R & D work because the manufacturer couldn't obtain R & D money.

'Snark' Case Cited

Gen. Power has taken the position that at the point that a "developmental plan" has been accepted or a contractual source selected, projects should be financed by AMC. Putt has taken the position that, instead, "The additional funds that we need should be obtained in a straightforward request for an increase in the research and development appropriation".

Although Northrop Aircraft Co.'s "Snark" guided missile has been a research and development program for years, it was pointed out, 68% ($141 million) has been financed by production contracts and only 32% by the R & D command.

Northrop sought to have the "Snark" put under a single R & D contract, since this would eliminate "the productions philosophy and requirements of the production contract." The Air Force refused.

At subcommittee session's on the staff report, Mahon told Defense Secretary Charles Wilson and other Defense Department and service officials that the "Snark" has "been just a twinkle in somebody's eye for a long period. It is a little confusing to call it production. . . . It seems to me that the Department needs more research and development money . . . so much of 'production' now is really research and development."

Wilson's Hindsight

Wilson assured the subcommittee that there would be a clarification of the development area between research and development and production. "With the benefit of hindsight," Wilson conceded that "we should not have ordered as many Snarks as we did. We should have had a greater concentration of improvements on a reduced number of missiles."

Report Hits Delays

Findings of the Appropriation Subcommittee's staff report were:

• **"Frequent delays** in establishing firm target prices on incentive and price redeterminable type contracts have seriously impaired the government's negotiating position and have, in effect, defeated the purpose for which these types of contracts were designed. The labeling of incentive type contracts as fixed price contracts, whereas in fact they provide for reimbursement of cost

Airframe Industry Financial Data

Compiled by the House Armed Services Investigation Subcommittee from Material Furnished by Industry.

CALENDAR YEAR 1955

Company	Total Sales	Government Sales	Profit (Before Taxes)	No. of Company Officers	Total Paid to Company Officers	Earned 1952	Surplus 1955	Net 1952	Worth 1955
Boeing	853,827,722	99.7	7.34	12	580,643	53,998,612	104,644,856	67,552,946	119,167,922
North American	816,676,329	99.6	8.3	10	993,250	50,895,779	88,141,513	57,440,750	94,686,284
Douglas	772,818,969	88.9	5.231	16	793,019	51,407,521	102,787,332	81,407,521	134,347,267
McDonnell	719,367,939	100.	7.40	7	271,625	6,810,497	18,166,920	12,198,738	24,055,999
Lockheed	673,589,000	80.9	6.2	14	898,222	41,971,762	68,902,391	55,397,997	97,777,627
Republic	533,441,000	99.9	5.7	13	561,624	15,975,800	27,518,118	19,047,784	42,806,152
Convair	482,923,000	96.7	6.1	11	570,905	(Became Division of General Dynamics, April, 1954)			
Glenn L. Martin	271,862,342	99.7	7.34	9	494,416	−6,482,922	23,659,251	11,051,264	52,144,710
Northrop	256,541,000	99.98	9.07	13	653,746	6,943,151	20,927,374	9,469,948	25,297,099
Grumman	213,353,647	98.99	9.96	11	520,437	22,834,889	27,147,626	32,834,889	44,747,626
Fairchild	154,412,491	99.4	5.87	10	616,572	14,558,167	21,200,000	21,150,189	35,640,477
Chance Vought	146,000,000	99.9	7.0	7	319,040	.....	8,800,000	17,362,303	26,161,303

incurred plus a profit (with an overall ceiling), is admittedly poor practice. These contracts are flexible contracts and should be called such.

• "**Unconscionable delays** have taken place in formalizing letter contracts into definitive contracts, diluting the government's opportunity to obtain fair and reasonable prices because the contractor realizes the government can little afford to cancel work in process with the attendant production delays and added costs. The great abuses in this area concern the so-called calculated risks taken by the government starting into production on untried and unproven equipment, and the position of the military services that the 'state of the art' does not lend itself to definitive specifications at the beginning of certain secret and complex production contracts."

• "**Weaknesses in** the requirement computations, inaccurate inventories, inadequate stock records, excessive paperwork and lack of price control have hindered efficient and economical procurement of spare parts."

The major weakness in the procurement of aircraft and engines, the report stated, is the inability of negotiators to evaluate the "target" estimates of contractors.

"If the negotiator had access to the contractor's working papers of estimates," it was suggested, "some realistic evaluation could be made of the contractor's figures."

As an example of the inaccuracy of the target prices and redetermined prices agreed to by government negotiators it was reported that even after re-determination, Ford Motor Co. made voluntary refunds of over $7.8 million on the R-4360 engine.

"Treating incentive fixed price contracts as firm fixed price contracts eliminates the audit controls which the government provides in cost-plus-fixed-fee contracts," the report said. "Thus, the government becomes a party to what amounts to a cost reimbursible contract while losing some of the safeguards which it has found wise to maintain and establish in administration of the cost-plus-fixed-fee contracts."

Penalties Suggested

The report also criticized the long delays in setting firm targets due to insufficient cost background or the reluctance of contractor or government negotiator to make commitments involving uncertainties.

"Delays in fixing firm targets," it was pointed out, "decrease the incentive to save money and give the incentive contract a cost-plus-a-percentage-of-cost complexion during the period preceding the fixing of the firm target." As of June 30, 1955, it was reported, Bureau of Aeronautics had incentive type contracts on which firm target prices had not been set valued at $1.4 billion and dating back to February, 1951.

The report suggested that penalty clauses be included in production contracts to assure that schedules are met. "Many contract files show one delivery date extension after another and the impression is gained that delivery is a relatively unimportant detail, in spite of the fact that many contracts have been awarded on the basis of a particular contractor's ability to meet a required delivery schedule," the report stated.

On contract reviews in all three services, the report maintained that "these for the most part are examinations as to form and often amount to mere acceptance of the negotiator's recommendation with no critical analysis of the underlying data.

Such reviews build a paper record tending to show careful consideration but serve only to delay final action.

The "independence" of contract reviews at Air Materiel Command headquarters by the "Air Force Procurement Committee," the report declared, is "more theoretical than factual." The consensus of negotiators, according to the report, is that the Review Committee increases their workload, slows down buying and dilutes their authority. "A common complaint of the negotiators was that the committee would raise questions on relatively insignificant details and that it was only on rare occasions that the committee would give policy guidance or firm answers."

Rushed Production

The report detailed numerous examples in which R & D projects had been prematurely rushed into production status.

They also illustrate "the fact that production funds are being used fairly indiscriminately to support development activities under the guise of production contracts."

The examples included: the F10F-1 program of Grumman Aircraft Engineering Corp.; the R3Y seaplane project of Convair; the A2D-1 attack aircraft program of Douglas Aircraft Co.; the T-40-A-6 and the T-40-A-10 engine program of the Allison Division of General Motors Corp.; the F3H-1 program of McDonnell Aircraft Corp.; the J40 jet engine program of Westinghouse Electric Corp.; the F7U-3 Cutlass fighter program of Chance Vought Aircraft.

(SEE NEXT PAGE for a detailed report on salaries and bonuses by three large airframe companies.)

Industry Report on Salaries, Bonuses

Tables of salaries and bonuses totaling more than $25,000 annually as reported by three aircraft companies to House Armed Services Investigating Subcommittee are shown below:

Chance Vought Aircraft, Inc.

	Salary 1952	Bonus	Salary 1953	Bonus	Salary 1954	Bonus	Salary 1955	Bonus
F. O. Detweiler, General Manager, President	$35,874	$12,500	$40,000	$15,000	$45,000	$20,000	$50,000	$22,500
C. J. McCarthy, Chairman of Board	.....	.....	.....	.....	21,250	.....	42,500	17,500
H. B. Sallada, Assistant General Manager, Vice President	.....	.....	20,333	.....	30,000	5,000	35,000	14,000
N. V. Turney, Vice President and Controller	19,024	2,700	20,000	3,000	25,000	4,000	35,000	14,000
R. C. Blaylock, Vice President, Engineering	.....	.....	19,800	1,700	21,674	3,000	27,916	8,000
C. E. Burt, Vice President, Production	.....	.....	19,199	1,600	22,500	3,500	23,958	10,000
W. P. Thayer, Vice President, Sales and Service	.....	.....	21,666	3,000	22,000	3,500	23,166	8,000
J. J. Gaffney, Admin. Asst.	20,000	2,200	20,000	2,200	.....	.....	.....	.....
F. N. Wickerman (Resigned 5-31-55), Dir. of Engineering	22,833	2,800	23,999	3,000	26,666	4,000	12,500	9,000
P. S. Baker (Resigned 6-30-53), Engineering Manager	25,000	2,200	.....	.....	.....	.....	.....	.....
G. K. Johnson, Dir. Opr. Plans and Controls	.....	.....	.....	.....	18,400	1,800	20,166	3,400
J. R. Clark, Assistant Chemical Engineer, Aircraft Projects	.....	.....	.....	.....	18,304	2,000	20,333	4,000
H. B. Gibbons, Asst. Ch. Eng., Tech.	.....	.....	.....	.....	18,166	2,000	19,333	4,000
B. D. Taliaferro (Resigned 4-30-53), Factory Manager	22,000	2,500	.....	.....	.....	.....	.....	.....
TOTAL	$144,731	$24,900	$184,997	$29,500	$278,960	$48,800	$309,972	$114,400

Northrop Aircraft, Inc.

(Year Ended Dec. 31)	Salary 1952	Bonus	Salary 1953	Bonus	Salary 1954	Bonus	Salary 1955	Bonus
John K. Northrop, President and Director	$51,979	.....	.....	.....	.....	.....	.....	.....
Oliver P. Echols, Chairman of Board and General Manager	60,000	.....	$60,000	.....	$62,071	.....	.....	.....
Roland J. Pagen, Vice President, Treasurer and Director	31,187	.....	33,250	.....	36,208	.....	$40,291	$20,500
John W. Myers, Vice President and Director (Resigned 6-55)	31,187	.....	33,250	.....	36,208	.....	57,687	.....
Kenneth P. Bowen, Vice President, Manufacturing	31,187	.....	33,250	.....	36,208	.....	40,291	20,000
Edgar Schmued, Vice President, Engineering	.....	.....	26,666	.....	41,380	.....	45,541	22,500
George Gore, Secretary, Corporation Counsel	.....	.....	.....	.....	20,388	.....	24,708	7,500
W. J. Cerny, Assistant to President	.....	.....	21,000	.....	23,847	.....	.....	.....
R. R. Nolan, Manager, Anaheim Division	.....	.....	23,099	.....	23,899	.....	25,051	12,500
C. B. Spencer, Factory Manager, Hawthorne	.....	.....	.....	.....	20,293	.....	22,004	8,000
W. F. Ballhaus, Chief Engineer	.....	.....	.....	.....	28,218	.....	29,942	12,000
Whitley C. Collins, President and Director	.....	.....	.....	.....	.....	.....	82,083	42,500
William C. McDuffie, Chairman of Board	.....	.....	.....	.....	.....	.....	32,083	17,500
John R. Alison, Vice President, Administration	.....	.....	.....	.....	.....	.....	33,145	17,500
Robert R. Miller, Vice President, Assistant to President	.....	.....	.....	.....	.....	.....	26,320	16,500
A. C. Morgan, Assistant Secretary	.....	.....	.....	.....	.....	.....	26,000	10,500
S. W. Towle, Jr., Assistant Secretary (Washington)	.....	.....	.....	.....	.....	.....	17,796	8,000
Charles Cilley, Assistant Treasurer	.....	.....	.....	.....	.....	.....	16,589	7,000
F. J. Baum, Assistant Secretary (Dayton)	.....	.....	.....	.....	.....	.....	15,748	5,500
T. V. Jones, Deputy Chief Engineer	.....	.....	.....	.....	.....	.....	22,050	6,500
W. E. Gasich, Chief, Prelim. & Conf. Design	.....	.....	.....	.....	.....	.....	20,754	10,000
R. P. Jackson, Chief Analytical Engineer	.....	.....	.....	.....	.....	.....	20,716	6,000
G. F. Douglas, Assistant Chief Engineer	.....	.....	.....	.....	.....	.....	17,847	6,500
P. O. Wierk, Chief Adm. Engineer	.....	.....	.....	.....	.....	.....	17,546	8,500
W. E. Woolwine, Chief Design Engineer	.....	.....	.....	.....	.....	.....	17,118	3,500
T. H. Quayle, Assistant Manager, Anaheim Division	.....	.....	.....	.....	.....	.....	19,682	6,000
J. S. Breneman, Assistant Factory Manager	.....	.....	.....	.....	.....	.....	17,507	3,500
R. A. Hall, Chief, Missile Mfg.	.....	.....	.....	.....	.....	.....	18,539	5,500
F. W. Lloyd, General Superintendent	.....	.....	.....	.....	.....	.....	17,786	5,500
D. W. Kraybill, General Superintendent Tool Operations	.....	.....	.....	.....	.....	.....	17,601	5,500
J. W. Hinchliffe, Dir. of Material	.....	.....	.....	.....	.....	.....	17,702	5,500
B. R. Bonnett, Mgr. Ind. & Plant Eng.	.....	.....	.....	.....	.....	.....	16,217	5,000
R. S. Catlin, Director Quality Control	.....	.....	.....	.....	.....	.....	16,247	8,000
M. R. Stanley, Chief of Flight	.....	.....	.....	.....	.....	.....	17,385	5,500
F. E. Christofferson, Assistant Chief of Flight	.....	.....	.....	.....	.....	.....	22,400	5,000
L. A. Nelson, Flight Supervisor	.....	.....	.....	.....	.....	.....	20,378	.....
J. B. Clark, Dir. Ind. Relations	.....	.....	.....	.....	.....	.....	20,369	8,000
G. H. Buchner, Dir. Contract Adm.	.....	.....	.....	.....	.....	.....	14,494	8,000
L. H. Smith, Manager Customer Service	.....	.....	.....	.....	.....	.....	14,466	7,500
G. C. Mahan, Chief Tax Accountant	.....	.....	.....	.....	.....	.....	15,506	5,000
J. G. Nettleton, Jr., Assistant to the President	.....	.....	.....	.....	.....	.....	21,854	9,000
H. C. Miller, Assistant to President	.....	.....	.....	.....	.....	.....	14,073	10,000
R. D. Gayner, Assistant to V. P. Mfg.	.....	.....	.....	.....	.....	.....	21,549	6,500
F. P. Holter, Assistant to V. P. Admin.	.....	.....	.....	.....	.....	.....	18,332	5,500
TOTAL	$205,541	.....	$230,516	.....	$328,725	.....	$993,351	$384,000

Grumman Aircraft Engineering Corp.

(Year Ended Dec. 31)	Salary 1952	Bonus	Salary 1953	Bonus	Salary 1954	Bonus	Salary 1955 (Year Ended Dec. 31)	Bonus
L. R. Grumman, Chairman of Board	$51,250	.....	$55,000	.....	$61,667	.....	$74,375	.....
L. A. Swirbul, President	61,500	.....	66,000	.....	72,000	.....	90,625	.....
W. T. Schwendler, Executive Vice President	51,250	.....	55,000	.....	61,666	.....	74,375	.....
E. Clinton Towl, Administrative Vice President	32,800	.....	35,200	.....	39,733	.....	45,430	.....
R. L. Hall	29,294	9,396	31,263	9,306	33,449	7,356	42,875	.....
George F. Titterton	29,294	9,396	31,263	9,306	37,819	2,986	43,500	.....
Charles Kingsley	22,933	4,544	23,409	4,479	25,225	3,583	31,650	.....
David Rittenhouse	26,481	7,206	28,263	7,181	29,991	5,690	37,175	.....
W. J. Hoffman	23,833	6,085	24,409	6,020	26,591	4,783	33,175	.....
E. W. Poor	20,500	.....	22,000	.....	22,666	.....	23,625	.....
J. A. Stamm	20,500	.....	22,000	.....	22,666	.....	23,625	.....
	(All Figures Below Are Thru 6-30-55)							
W. L. Sutton	23,001	4,552	23,785	4,502	24,664	4,534	12,573	2,267
Harry Larson	17,901	3,835	18,409	3,770	19,570	3,826	9,361	1,913
H. T. Schiebel, Jr.	20,789	3,150	21,463	3,138	22,323	3,284	11,323	1,642
Richard Hutton	20,226	4,939	21,185	4,898	22,489	4,949	12,067	2,474
Oscar Erlandson	21,126	3,969	21,609	3,904	22,546	3,950	11,447	1,975
C. H. Meyer	12,581	7,853	13,268	7,988	14,613	9,507	.....	.....
R. H. Donnell	11,701	10,599	12,823	8,693	.....	.....	.....	.....
Gordon Israel	17,526	2,687	.....	.....	.....	.....	.....	.....
C. S. Lyon	15,000	5,875	.....	.....	15,000	16,144	7,500	11,328
I. G. Hedrick	.....	.....	18,253	2,617	20,501	3,378	10,992	1,689
D. W. Field	.....	.....	.....	.....	17,627	2,741	9,073	1,382
W. J. Cochran	.....	.....	.....	.....	13,825	11,638	7,323	3,335
S. A. Converse	.....	.....	.....	.....	17,660	2,756	8,948	1,378
Oscar F. Olsen	.....	.....	.....	.....	17,435	2,732	9,492	1,366
A. J. Zuzi	.....	.....	.....	.....	19,334	3,878	10,992	1,939
Herbert Crawford	.....	.....	.....	.....	.....	.....	9,216	883
J. G. Gavin	.....	.....	.....	.....	.....	.....	9,650	864
Charles Tilgner	.....	.....	.....	.....	.....	.....	8,822	1,474
Roger Kahn	.....	.....	.....	.....	.....	.....	8,823	1,372
TOTAL	$529,492	$83,952	$554,609	$75,808	$681,069	$97,822	$413,293	$37,286

New Russian Jet Airliner Visits London

London—Russian Tupolev 104 jet airliner made its first western appearance last week bringing Soviet Security Chief Ivan Serov into London Airport.

Sweptwing, twin-jet aircraft, based on the military Badger bomber, made the 1,500 mile flight from Moscow with one stop at Berlin. Silver jet bears blue Aeroflot markings and Red flag. It appears to be fairly conventional jet aircraft.

Short wings are swept approximately 30 degrees with large jet engines set close inboard. Separate nacelles accommodate double-truck main landing gear. Controls appear conventional with servotabs on ailerons and nonflying tail.

Fifteen round windows are placed on each side of fuselage. Thick wing and blunt military greenhouse nose make it seem unlikely that cruising speed can be much over 450 to 500 mph.

Fuselage length is estimated at 100 ft., and weight approximately 100,000 lb.

Piasecki Offers Stock, Reveals Work Plans

Piasecki Aircraft Corp., Philadelphia, is offering 75,000 shares of common stock for public sale at $8 a share. Par value is $1.

The company is headed by Frank N. Piasecki, former president and board chairman of Piasecki Helicopter Corp., which has changed its name to Vertol Aircraft Corp. There is an effort underway now to unseat Piasecki, Donald N. Meyers and James J. Davis as directors of Vertol.

The prospectus for the new stock issue says Piasecki Aircraft has no orders or assurances of orders but has submitted three proposals to the armed forces. These include a large jet-driven helicopter, a VTOL aircraft and a helicopter drone.

In an earlier preliminary registration statement filed with the Securities and Exchange Commission, Piasecki Aircraft proposed offering 200,000 shares of stock at $10 to $11 a share. (AW Feb. 13, p. 35).

The prospectus says the company owns 105,797 shares of Piasecki Helicopter (Vertol) stock and declares "there is no conflict of interest or direct competition between the company and Piasecki Helicopter Corp. (Vertol)."

Sharp disagreement with this viewpoint has been expressed by Don R. Berlin, president and board chairman of Vertol.

Piasecki Aircraft says it now employs 23 persons, including 11 engineers. It says its engineers, while associated with Vertol, were basically responsible for that company's designs. It adds that patents held by Vertol will be available for the new Piasecki firm under the pooling arrangements of the Aircraft Industries Assn.

New Post for Gen. Wood

Baltimore—Change in command of the USAF Flight Test Center at Edwards AFB Calif. will take place June 11 with Maj. Gen. Floyd B. Wood relieving Brig. Gen. Stanley Holtoner. General Wood is now deputy commander in charge of research and development for the Air Research and Development Command. General Holtoner will be reassigned to the Far East Air Force in Japan.

Upon General Wood's departure from ARDC headquarters his post there will be filled by his current assistant Brig. Gen. Marvin C. Demler. Col. Homer Boushey, now chief of staff at Wright Air Development Center will move to Baltimore to become General Demler's assistant.

Senators' Want Tests Of Rival Nike, Talos

Washington—Army and Air Force officials will be called to Capitol Hill this week to defend the Nike and Talos defensive missiles.

Sen. Henry M. Jackson (D.-Wash.) also has called for "realistic tests" of the two missiles before the Senate Armed Services Real Estate and Military Construction Subcommittee approves funds for more Army Nike bases here and abroad and USAF facilities for the Navy-developed Talos near Strategic Air Command bases in this country (AW Mar. 12, p. 341).

Sen. Jackson's call was quickly backed by the subcommittee's chairman, Sen. John Stennis (D.-Miss.), and Sen. Francis Case (R.-S. D.).

Air Force Undersecretary James H. Douglas also supported the idea, and Army Secretary Wilber M. Brucker reportedly told Defense Secretary Charles E. Wilson that the Army had no objection.

Air Force Makes 10% Cut In Republic F-84F Order

Washington—U. S. Air Force has cut orders for Republic Aviation Corp.'s F-84F Thunderstreak jet fighters and RF-84F Thunderflash jet reconnaissance planes by approximately 10%, or about 250 planes.

USAF said the reduction affects planes which would have been produced after March, 1957, and is the result of a reappraisal of USAF and NATO needs "in the light of the availability of more advanced aircraft of the Century series." The F-84F is in the 650-mile-an-hour class.

Westinghouse Strike Ends After 156 Days

Pittsburgh—Agreement on a new five-year contract brought final end last week to the 156-day-old strike of Westinghouse Electric Corp. plants by 44,000 members of the International Union of Electrical Workers—AFL-CIO. The new contract is retroactive to the time the strike began.

The agreement provides for annual wage increases of about 3% now with a minimum of five cents an hour again on Oct. 15, 1956 and again on Oct. 14, 1957. In the final two years, an increase of about 3.5% over the present rates will be effected on Oct. 13, 1958 and Oct. 12, 1959. Also included are a cost-of-living provision, and increases in fringe benefits.

The firm may conduct time studies on day-work production operations, the company reports; a major stumbling block during negotiations.

Germans Renew Rocketry

Bonn—The German association of Rocket Engineers (AFRA) plans to fire a three-step rocket that will reach a height of at least 60,000 feet as its contribution to the "Geophysical Year 1957." The rocket will be fired near the North Sea port of Cuxhaven.

The association, which numbers about 200 members, has fired about 20 rockets since the spring of 1954. Its members are trying to develop a novel rocket propellant and a rocket directed by a pilot beam that can be returned to its launching site.

At ASME Meeting:

Furnas Warns Against 'Earthbound' Design

Los Angeles—Assistant Secretary of Defense for Research and Development Clifford C. Furnas warned industry leaders here in a plea for less "earthbound" thinking that today's military aircraft is designed under such a welter of compromises it "tends to become a tank car with a saddle on it, with a streak of hot gas streaming out of the rear."

Speaking before a meeting of the Aviation Division Conference of the American Society of Mechanical Engineers, Dr. Furnas said military pressures for more speed and altitude with available powerplants have forced a large segment of industry to lose its objectivity in aircraft design. As it is now, he said:

"Since we must go fast, we then must have very small wings with very heavy wing loadings. This means we have very high landing and takeoff speeds and hence must have very long runways.

"The Air Force has had a difficult time keeping its runway lengths ahead of the needs.

Civilian Problem As Well

"This isn't just a military problem—it's a civilian one as well . . . Pan American . . . stated that perhaps 18 of the 233 airports it uses around the world might accommodate their forthcoming jet transports.

"I think these things lead to an inevitable conclusion, namely that we must re-examine the compromises we have made and the factors which forced us to these compromises."

". . . Can we not swap some altitude (and speed) for (less) concrete.

Optimum Powerplant

"What would an airplane look like if it were designed to have a normal cruise speed of Mach 0.2 at sea level and one of Mach 2.0 at 80,000 ft?

"Would the optimum powerplant be the now-lowly turboprop, a ducted fan, a shrouded propeller, a ramjet or something else? Or would it be a unique combination of some of these?

"My whole point is that our thinking on the airplane–powerplant combination has been a bit too earthbound. We've tended to look on speed and altitude as barriers to be overcome, whereas actually they may be a most helpful variable in our matrix of compromises."

As a case in point, Dr. Furnas pointed to the development of vertical-takeoff-and-landing aircraft where, he said, "past compromises have driven us into a corner, a powerplant corner."

VTOL Future

"Most of the advantages of VTOL and STOL," he told the meeting, "are obvious and quite well known. . . . However, all the approaches at this time are more or less improvised for the simple reason that no powerplant has been designed or seriously worked on to optimize the variables involved in the VTOL problem."

Furnas and Wilson

But despite this, he said, and despite the fact that progress toward "satisfactory" vertical takeoff fixed-wing aircraft "will be seriously delayed," the urge for ever-higher speeds in conventional type aircraft "has resulted in powerplants that have made the VTOL almost feasible."

After his talk, Dr. Furnas lent weight to earlier reports by his supports that he has won a "clean victory" in the battle over control of weapons development (AW Mar. 19, p. 34).

The Assistant Secretary said he and Defense Secretary Charles E. Wilson were in "basic agreement" over the fact that research and development belonged together (in Furnas' office), although some details still have to be worked out as to when an item ceases to be developmental and becomes production hardware.

These, he added, should be resolved within the next few weeks.

Secretary Wilson already has admitted he acted too hastily in issuing a Feb. 21 memorandum which appeared to shift responsibility for development from Dr. Furnas to Frank D. Newbury, Assistant Secretary for Applications Engineering (AW Mar. 5, p. 27).

ASME Told of Industry Progress

With Secretary Furnas setting the keynote, other speakers took to the rostrum during the 3-day-long ASME meeting to describe a variety of recent developments, problems and promises of the future.

They included:

- **Problems of high-speed aircraft** design and promising lines of solution: **George S. Schairer, assistant chief engineer, Boeing Airplane Co.**
- **"The Challenge of Progress,"** outlining basic knowledge that may boost the capability of current fighters and interceptors still in the developmental stage: **R. C. Sebold, vice president-engineering, Convair.**
- **Needed engine thrusts** for Mach 2.5 aircraft: **Welko Gasich, chief of preliminary design, Northrop Aircraft.**
- **Ventilated clothing to protect** crewmen of aircraft entering the "thermal thicket:" **Paul Webb, Aero Medical Laboratory, Wright Air Development Center.**
- **Plastic missiles** are possible now: **Gerald E. Dodson, chief engineer, Reinforced Plastics Division, H. I. Thompson Fiberglass Co.**

Schairer on High-Speed

George S. Schairer, assistant chief engineer, Boeing Airplane Co., delivered a paper before the conference assembling, correlating and analyzing problems of large high-speed aircraft and indicated promising lines of solution.

In dealing with structures of large aircraft encountering aerodynamic heating from high speeds, Schairer pointed out:

- **Some structures** (like flaps) encounter loads only at low speeds and temperatures but still must be designed to suffer aerodynamic heating for certain periods of flight time, during which they must not lose their low temperature properties.
- **In certain load bearing structures** encountering acrodynamic heating and loads simultaneously, the loads are lower than maximum due to the aerodynamics of high-speed flight. Therefore, the material may be losing strength at the same time it is carrying lower loads.
- **Titanium sandwich structures** show excellent promise in the area where compressive loads are the design criteria at high temperature.
- **Certain materials (like man),** cannot be replaced by high temperature mate-

ASME Report

The report on the 3-day-long meeting of the Aviation Division Conference of the American Society of Mechanical Engineers, which begins on this page, was prepared by the staff of Aviation Week's West Coast Bureau: Irving Stone, Richard Sweeney and Bernie Lang. For their report on ASME discussions regarding the transport industry, see page 95.

Concepts

rials. They will have to be temperature conditioned.

• **Aerodynamic heating** will bring new standards for allowable "creep" deflection considerably below .001 in. per in. This will require that stresses be kept quite modest at high temperature and may also limit the number of high temperature flying hours.

High-Speed Aerodynamics

Regarding aerodynamics, stability and control of large high-speed aircraft, the paper concluded:

• **At supersonic speeds** large aircraft will turn to low aspect ratios and very low thickness ratios. Because of lift-drag ratio, acquiring extended ranges from this type high-Mach-number plane will present a serious problem.

• **The low aspect ratios** of supersonic speed will change downwash angle and bring a radical change in the stability effects of the horizontal tail surfaces, causing either unusual surface location or, in some cases, its elimination.

• **A given control surface** will produce much less control in supersonic flight than in subsonic. Hinge moments will increase, and loading will occur further back along the movable surface. Adding to these problems, is the elimination of the aerodynamic tab as an aid in aerodynamic balance of boost.

• **Such an aircraft combines** practically all the factors that give flutter investigators nightmares. Flexibility is increasing, natural frequencies are coming down, distributed air masses remain quite large, speed areas are going up.

Sebold: 'Progress'

A paper by R. C. Sebold, vice president-engineering, Convair, on "The Challenge of Progress" pointed out that basic knowledge may boost capability of current development fighters and interceptors.

Explaining that kinetic energy can be exchanged for potential energy and vice versa, Seabold said a fighter capable of traveling at Mach 1.5 at 35,000 ft. could trade speed for altitude, achieve 50,000 ft. and stay at Mach .9, which would still be enough to mount an attack.

Using the same constant energy curve on a chart with Mach number and altitude scales, Sebold said an aircraft flying at Mach 3.5 at 35,000 ft. could exchange speed for altitude, achieve 80,000 ft. and retain Mach 3 for mounting its attack.

This same approach has been used in missile flight for some time. Aircraft however, are only now entering the areas of Mach number and altitude where this becomes feasible.

LEADERS OF ASME AVIATION DIVISION conference included (l. to r.): **R. M. Hatfield, chairman of Aviation Division's Southern California Section; John K. Northrop, arrangements committee chairman; Dr. C. C. Furnas, and Dr. Joseph Barker, ASME president.**

Gasich: Engine Needs

The future interceptor, capable of Mach 2.5 speeds, and 75,000 ft. altitudes, will weigh between 80,000 and 100,000 lbs., have from 300-to-500 mi. range and be built from titanium and steel.

To achieve these standards, multiple engine installations capable of total static sea level thrust of from 30,000 to 50,000 lb. will be required, Welko Gasich, chief of preliminary design, Northrop Aircraft Inc., told a propulsion section meeting at the ASME conference.

In a paper entitled, "What We Need in Engines," Gasich said the powerplants most likely will be afterburner types since on-afterburner engines of equivalent thrust weigh 15% more, too high a penalty to pay at high altitude for the 25% specific fuel consumption saving. These engines, he said, will have 6-1 or 8-1 compression ratios instead of today's 10-1 or 12-1. At higher speeds, the ratio may fall lower, Gasich said.

He also outlined a hypothetical mission requirement for an interceptor,

Test Pilots on Engineers

Los Angeles—Industry test pilots took advantage of an opportunity to air their disagreements with, and/or suggestions to, aircraft design engineers during a panel discussion at the American Society of Mechanical Engineers' Aviation Division Conference here. The pilots and their thoughts included:

• A. M. (Tex) Johnston, Boeing chief test pilot: Human factors have failed to receive proper consideration; there is a need for better communication between the various engineering groups so that systems and components will be compatible when assembled in the aircraft.

• Joseph Walker, National Advisory Committee for Aeronautics: Engineering theory and practice are not sufficiently correlated—"We have a tough time trying to explain to the engineer what the plane did if it didn't perform in the desired direction."

• Lewis Nelson, Northrop chief test pilot: Engineers sometimes forget that the human being is not progressing at the same rate as that of aircraft design. Nelson also called for more foresight, less hindsight—"Too many times have I heard an engineer say, after something came apart, 'I thought that might happen.'"

• Richard Johnson, Convair chief experimental test pilot: Engineers have a "pride of authorship" which makes it difficult to explain to them that their product is no good.

• Bert Foulds, Douglas chief pilot: If engineers could guarantee a safe evacuation for test pilots, test programs would accelerate rapidly.

• Herman (Fish) Salmon, Lockheed chief engineering test pilot: Closer cooperation should exist between engineers, scientists and aero-medical groups to help the test pilot solve some of the problems confronting him.

MA-2 VENTILATED SUIT for flight into "thermal thicket" was described at ASME conference. Hose supplies all power needs.

which could reach 70,000 ft., cruise at Mach. 2.5 outbound 500 mi. to its point of attack, make its attack and cruise home subsonically.

For this interceptor, he said, five points would prevail:

- **Afterburner engine** would be more efficient than the non-afterburner engine.
- **Compressor ratio** would be 6-1 or 8-1.
- **Total thrust** would be 40,000 to 50,000 lb.
- **Lower specific weight** would be needed.
- **More thrust per unit** of frontal area would be needed.

Webb: Thermal Suits

The Air Force, faced with the problem of man as the weakest link in any weapons system which enters the "thermal thicket," has found that ventilated clothing can boost tolerance to heat appreciably.

The Aero Medical Laboratory, Wright Air Development Center, has developed a ventilating suit to protect crewmen of high performance aircraft against excessive heat exposure. Details of the garment, known as the MA-2 and now being standardized by the Air Force, were outlined by Paul Webb, Aero Medical Laboratory medical officer.

The theory behind the development of the ventilating suit is that amounts of cooled air needed to protect the crewman are much less than would be required to cool the entire cockpit. And Webb feels that aircraft designers will find it difficult to provide an even, comfortable temperature in the crew compartment, since the power needed for refrigeration would limit the aircraft's high performance.

The MA-2 ventilating garment consists of a double layer of vinyl film, between which is some loose spacer material. Air is delivered through a central hose to the space between the two layers. Resistance across this space is extremely low so that equal distribution of the air to all parts of the suit is assured.

Air can only escape from between the double layer through very fine holes in the inner layer. This allows the ventilating air to be delivered against the wearer's skin in a number of fine, high-velocity jets.

The air finally escapes by coming back through holes which pass through both layers of the garment. (When the ventilating garment is worn with an antiexposure suit, the final air exit is through one-way dump valves located at the ends of the arms and legs.)

Dodson: Plastic Missile

"The state of the manufacturing art is now at a point where complete missile of laminated (plastic) materials is possible," Gerald E. Dodson, chief engineer, Reinforced Plastic Division, H. I. Thompson Fiberglass Co., Los Angeles, told an American Rocket Society session at the ASME meeting.

Dodson said, however, that "in order to have satisfactory results it will be up to our designers to become well enough acquainted with processing and manufacturing techniques prior to actually attempting design of a completely laminated missile . . ."

The design techniques used in creating this laminated missile, he said, must be greatly different from those used in metal to utilize the best physical characteristics of these materials.

Dodson's paper, discussing high temperature, short-lived plastic laminates, listed three families of resins now in use that are suitable (cost and production-wise) for these applications:

- **Phenolic resins** have been successfully used at 4,500 degrees for periods of up to two minutes with extreme erosion conditions.
- **Silicone resins** have shown very satisfactory resistance for short time exposure at temperatures as high as 5,000 F.
- **Polyester resins.** Burn through tests of modified polyester resins indicate satisfactory short time service at 3,000 degrees.

An important part of laminates is the reinforcing material. Reinforcing fibers mentioned by Dodson were glass, asbestos, chemical quartz and natural quartz.

Avionics Unreliability Security Hazard

New York—Unreliability of military electronics equipment "represents a greater danger to our security" than possible lags in specific weapons development, Dudley C. Sharp, Assistant Secretary of the Air Force for Materiel, declared here last week.

Speaking before the fifth annual membership meeting of the Radio-Electronics-Television Manufacturers Association, Sharp added: "We are pinning our hopes for military supremacy to a large extent on electronic equipment."

Tracing the growth of avionics in the Air Force, Dudley said the cost of developing "the complex electronic system for a supersonic interceptor (believed to be the F-102 with its Hughes-developed avionics) . . . equalled the development cost of the aircraft itself."

The Assistant Secretary also said the interceptor's avionics equipment represents about one-third the total production cost of the airplane.

Today, he reported, approximately 17% of the Air Force budget, or roughly $3 billion, goes for avionics equipment, its maintenance and the salaries of civilian and military personnel involved in its procurement, use and maintenance.

A few years ago, the figure was 10%.

Citing one piece of complex airborne avionics which requires three hours of maintenance for each hour of use, Dudley said that aircraft availability for a mission may be determined more by the availability of maintenance facilities and skills than by the number of airplanes on hand.

The Air Force is fast approaching the time, he said, when it must procure avionic equipment with as much emphasis on reliability, simplicity and maintainability as for its performance. He added:

"We need to recognize that a (company's) reputation for good design is an important characteristic for a contract award, and proof that the design is good is a necessary condition for large scale production."

Vertol Sells H-21Cs To French Government

Paris—Vertol Corporation (formerly Piasecki) has sold 21 H-21C helicopters to the French government. Deliveries will begin in June 1956. The French order is being handled through the French Sncaso firm which is also being licensed by Vertol to handle H-21 maintenance and overhaul in France. Sncaso also has an option on a Vertol license to manufacture helicopters in France if there are future orders.

Scientists Reveal Vanguard Design Detail

New York—Specification and performance figures of the Project Vanguard earth satellite system were revealed here last week in a symposium before the Institute of Radio Engineers.

Milton W. Rosen, of the Naval Research Laboratory and technical director of Project Vanguard, indicated the magnitude of the problem posed by the project and the advances that have taken place in the state of rocketry art by comparing Vanguard and the altitude record holding Bumper-Wac research vehicle.

With approximately the same payload as that anticipated for Vanguard, the Bumper-Wac reached an altitude of 250 miles and a maximum velocity of 9,000 feet per second (6,200 miles per hour). Vanguard is expected to reach an altitude of 300 miles and a velocity greater than 25,000 feet per second (18,000 miles per hour).

The satellite vehicle is a three-stage, finless vehicle with guidance of the first two stages. The guidance equipment is located in the second stage. It includes a system of inertial references and will direct the flexible main powerplants of the first two stages to produce pitch and yaw control.

Power for the rotation of these motors upon their gimbals will be provided by electro-hydraulic systems. Roll control is provided by small tangentially-oriented rockets. The unguided third stage will be oriented in altitude, attitude and direction by the second stage which also will impart a stabilizing spin to the third unit before it is fired.

Before launching, the composite vehicle will be 72 ft. long and 45 in. in diameter at its widest point, giving a high fineness ratio of 19 to 1.

First Stage Resembles Viking

The first stage is similar to the Martin Viking research vehicle and is expected to provide about 15% of the orbital velocity and most of the energy needed to raise the last two stages to orbital altitude.

Its major propellants are gasoline and liquid oxygen fed from integral tanks by turbine-driven pumps. The tanks are pressurized with helium to prevent a build-up of back-pressure as fuel is consumed.

The second stage houses within its nose cone the third stage and the satellite payload. It is powered by a liquid-propellant rocket burning nitric acid and unsymmetrical dimethyl-hydrazine. The propellants are fed to the motor by highly pressurized helium.

An array of jet reactors will provide complete control after burnout of the second stage as the last two stages coast up to orbital altitude. The second stage is expected to attain about 32% of the orbital velocity, Rosen said.

The second stage nose cone covers the third stage and the satellite, protecting them from aerodynamic heating which might damage the delicate satellite. The cone will be jettisoned early during second stage burning when the lower density of the atmosphere reduces the danger of heating.

Third Stage

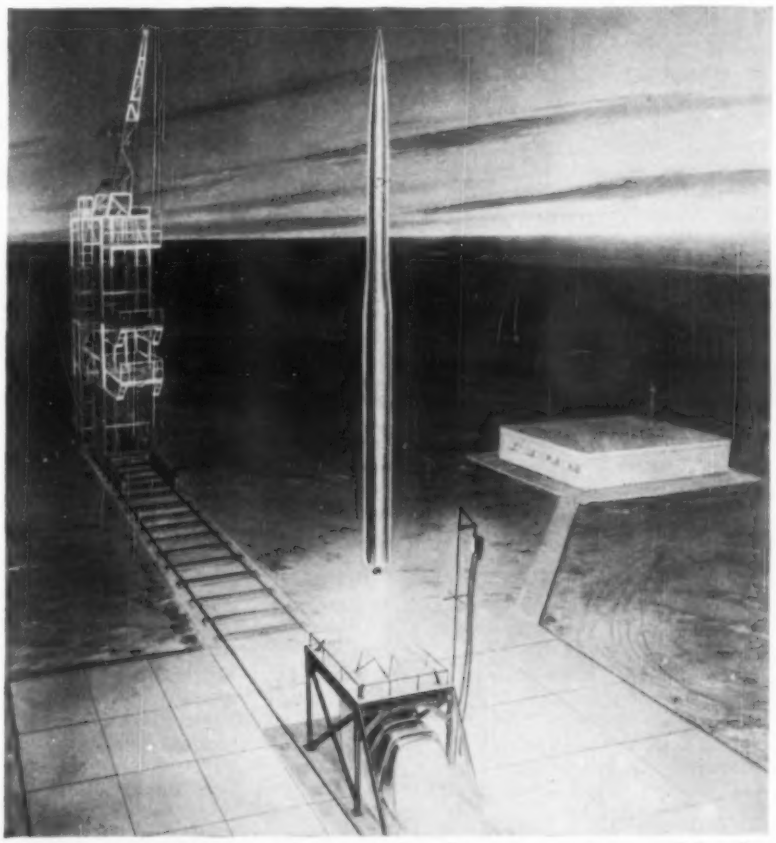
The third stage is an unguided solid propellant rocket which is spun upon its longitudinal axis to provide stability during its flight. It is fired at orbital altitude and provides about 50% of the orbital velocity.

After entering the orbit, the third stage and payload may be separated to continue in the orbit as two individual satellites. This would be done to prevent the heat soak of the third-stage motor from influencing the sensitive instruments in the payload. It also would ease the problem of locating telemetering antennas by reducing the possibility of body-produced antenna nulls. The weight penalty for this separation feature is not considered excessive, although a one-pound weight saving would give an additional velocity of 80 feet per second.

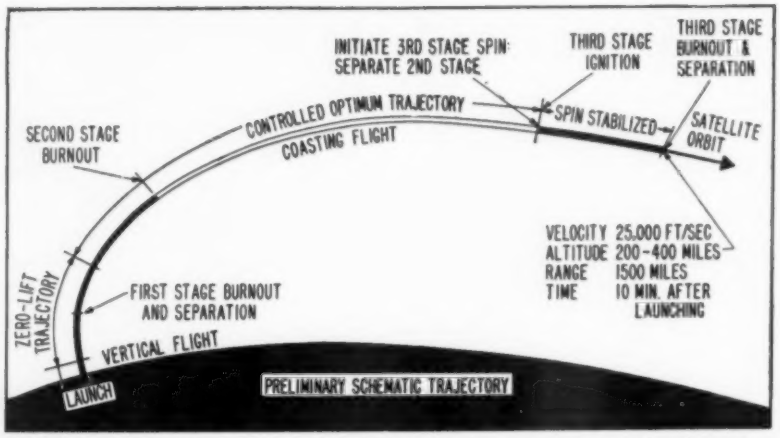
The Vanguard will be launched from Patrick AFB, Fla., on a heading between 28 degrees and 35 degrees south of east. This decision was made because of all the approximate meridional courses available, this one gains the most additional velocity from the earth's rotation and is most convenient for purposes of observation.

The vehicle will be launched vertically and then tilt gradually along its course. At first stage burn-out 36 miles above the earth, the angle of ascent will be about 45 degrees from the vertical. After second stage firing, the first stage will fall to earth about 230 miles from the launching site, a distance approximately equal to the range of the Army's Redstone missile.

The second stage will ascend along a progressively more inclined trajectory, reaching burn-out at an altitude of 140 miles. After burn-out, its velocity will carry it to a zenith 300 miles high and



PROJECT VANGUARD scientists' concept of satellite system as it roars off launcher.



GRAPH shows trajectory planners have outlined for the earth satellite after launching.

700 miles further along its horizontal course. At that point the oriented third stage will fire, Rosen said.

Extra Speed Margin of Error

Because of the accumulation of errors in second stage orientation, second stage zenith sensing and third stage stability during burning, it is impossible to place the satellite within a perfect orbit at an exact altitude. To allow a margin for the anticipated errors, the final velocity of the third stage will be greater than that required for a circular orbit. If the resulting cliptical orbit lies between a perigee (low point) altitude of 200 miles and an apogee (high point) altitude of 1,400 miles, the satellite will remain aloft long enough to accomplish its mission.

John P. Hagen, HRL's director of project Vanguard, told the IRE symposium that if the orbit has a perigee of 300 miles, the satellite will have a life of about a year. If it has a perigee of 200 miles, it will have a life of about 15 days and if its perigee is 100 miles its life will be less than one hour.

Dr. James A. Van Allen, State University of Iowa, pointed out that the satellite need not be the 20-inch, 21.5-lb. sphere now contemplated. Two other configurations are receiving attention. One is a minimum weight arrangement which would emphasize the gathering of telemetered data rather than visual observability and might remain attached to the third stage. The other is a large expandable sphere with excellent visibility but with no instrument carrying capacity.

A system of radio triangulation, called Minitrack, using phase comparison techniques will establish satellite position and its orbit, Dr. John T. Mengel told the symposium.

Dr. Mengel, also a member of the Naval Research Laboratory, is in charge of radio tracking.

Although Minitrack requires a rather elaborate arrangement of seven antennas at each ground station, it will permit the satellite itself to carry only an extremely small and lightweight radio transmitter. The satellite transmitter, consisting of a continuous-wave oscillator operating at 108 megacycles, will put out 10 to 50 milliwatts, Mengel reported.

Two alternate designs now under consideration, one using subminiature tubes and the other using transistors, will weigh only two and three pounds, respectively, including the antenna and a battery supply sufficient for several weeks operation.

Each Minitrack ground station will employ two pairs of antennas at right angles to one another to determine the satellite's position in the north-south and east-west directions, relative to the zenith, by comparing the relative phase of the satellite signals received at each antenna. Another set of three antennas will be required at each station to resolve ambiguities inherent in such a phase-comparison system.

Transmission of Data

Several dozen Minitrack ground stations are planned for installation along the 75th meridian. Within 20 minutes after the satellite has passed each station, the stations will have transmitted their data to one of several central computing centers where the orbit calculations will be run off.

In addition to these official minitrack stations, Project Vanguard hopes to enlist the aid of radio amateurs ("hams"), getting them to set up simplified two-antenna ground stations to provide supplemental data.

Although Vanguard officials expect to make use of optical as well as radio tracking, Mengel indicated that Minitrack is expected to provide sufficiently accurate data for scientists to establish the "ellipsoidal-ness" (out-of-roundness) of the earth to an accuracy never before possible. Despite errors caused by ionospheric refraction of the satellite signal, the use of data from several stations should make it possible to establish satellite position within a fraction of a milliradian, Mengel said.

Getting Back Data

Minitrack will provide a means of telemetering back a limited amount of satellite data, but a more sophisticated telemetering system also will be used for the bulk of the information. The Minitrack transmitter will telemeter back data only during brief 30-second intervals as the satellite nears an official ground station, triggered by a signal from the ground station.

Most of the data will be telemetered back via pulse-width modulation of an FM carrier in the regular 216 to 235 mc. telemetering band. This technique was selected, from many available, because the AF Missile Test Center from which the satellite will be launched is equipped to receive and handle this PWM type telemetering. A recently developed three-helical array ground antenna, with approximately 10 times the gain of previous units, is expected to be particularly helpful in picking up the low-level satellite signals, Dr. Donald G. Mazur told the symposium. Mazur, of NRL, is in charge of Vanguard telemetering.

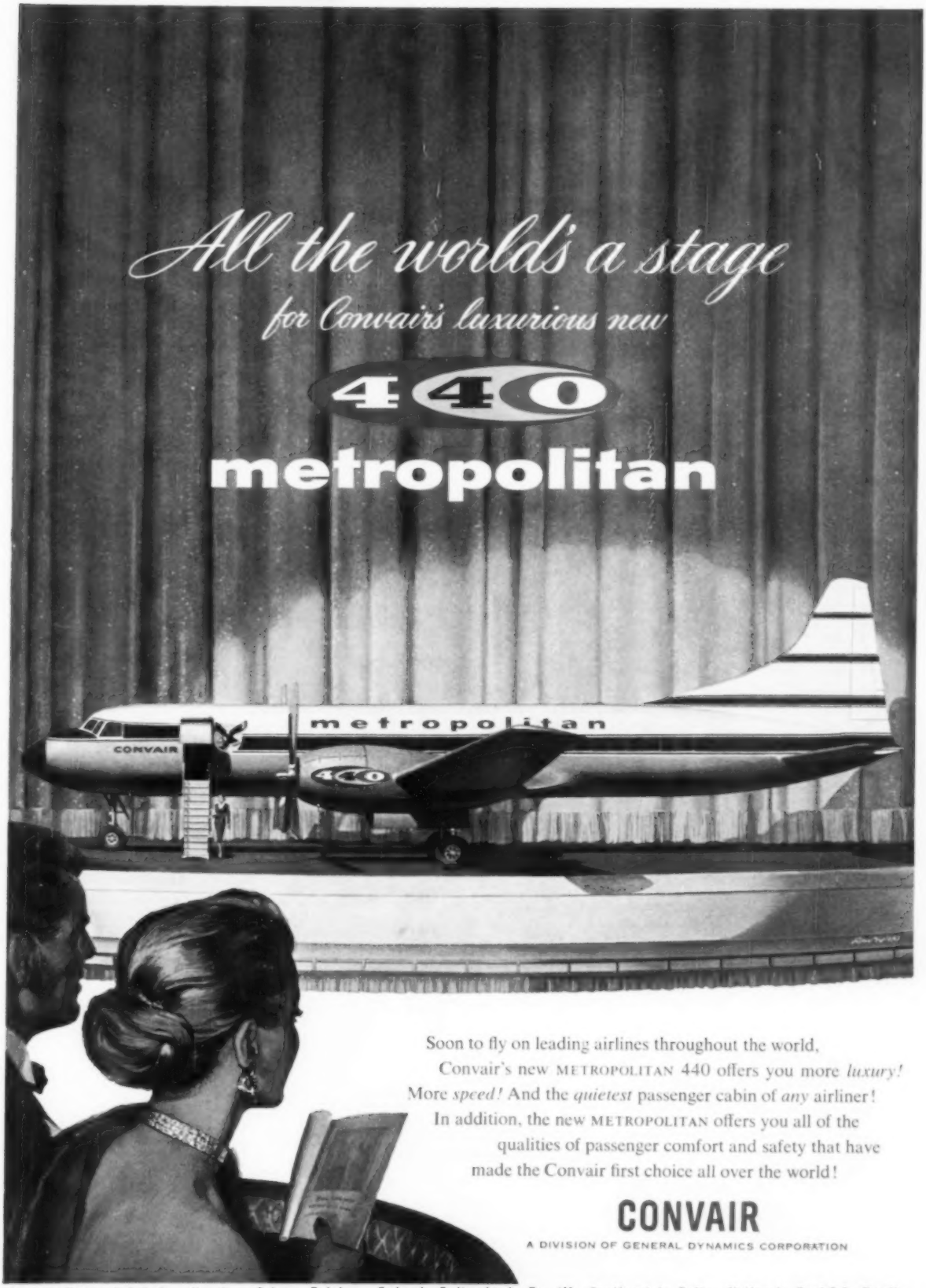
Because the satellite presents the first opportunity to obtain answers to questions which have long puzzled many branches of science, everyone wants to "get aboard" the satellite. For this reason, all requests are being carefully sifted and priorities are being assigned to each, Dr. Van Allen told the symposium.

The priorities are established on the basis of the scientific importance of the data, the technical feasibility of obtaining it and whether such data can be acquired by any other means, such as high-altitude balloons and rockets.

To date projects from six different research groups have been tentatively accepted for instrumentation in one or more of the satellites, Van Allen said.

These include measurement or determination of:

- **Percentage of earth covered by clouds.** Signal Corps Laboratory.
- **Presence and size of interplanetary** dust, and extreme ultraviolet radiation. Air Force Cambridge Research Center.
- **Electron density** above the F-layer region. Ballistic Research Laboratory, Aberdeen Proving Grounds.
- **Meteoric erosion** of the satellite. University of Maryland.
- **Intensity of solar and cosmic ray** radiation, upper atmosphere heating effect on satellite, and upper atmospheric pressure. Naval Research Laboratory.
- **Composition of primary cosmic** radiation. State University of Iowa.



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New Fairing for Gloster Javelin

A flared fairing has been added to the Mark 4 model of Britain's Gloster Javelin (above) between the twin jet exhausts. The fairing presumably was installed to reduce the interaction between the jet-engine exhaust and airflow over the flying tail. In above picture, Javelin's starting cartridge has just been fired by the pilot. Note blunt noses on Javelins below used for research test flying.

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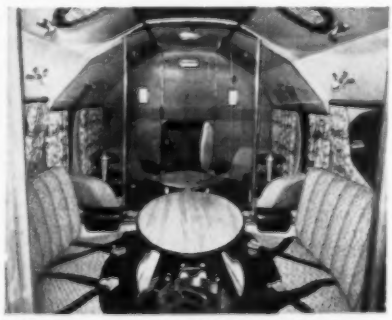

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TELEVISION SCREENS allow naval air station control tower personnel to monitor portions of a runway that are blocked from their vision by intervening buildings.

Alameda TV Circuit Aids Ground Control

Alameda, Calif.—A closed-circuit television application to aircraft traffic control has been installed at the naval air station here to relieve a potentially dangerous air traffic situation.

The system gives tower controllers positive sight of the last 1,000 ft. of final approach and the first 1,000 ft. of rollout on the station's Runway 25 Right, which has been blocked from tower view by the construction of new buildings.

Before installation of the television system, a one-man auxiliary tower was employed when the runway was in use.

The installation utilizes three cameras.

Each camera has a three-lense turret with 1-in. wide angle covering 35 deg., 2-in. standard covering 7 deg. and 6-in. telephoto covering 3 deg. In addition, the cameras have automatic iris control to compensate for sudden lighting changes.

Camera housings are weatherproof and have windscreen wipers for rainy days.

Also provided is an automatic second power source.

Specifications were laid out by the naval air station public works officer in cooperation with the base operations officer.

Five companies bid, with the contract going to Kay Laboratories, of San Diego, at $47,780.75.

Kay reports preliminary talks are now under way with Edwards Air Force Base for a closed circuit TV system there for better control of Edwards' 3-mi. runway. Holloman Air Force Base, New Mexico, also is interested in an application of closed circuit television for their particular needs, Kay representative said.

Loss of Control Caused Bonanza Crash

Washington—Structural failure of a Beech Bonanza when pilot Joel W. Thorne lost control has been blamed by the Civil Aeronautics Board in the fatal crash of the Bonanza last October in North Hollywood, Calif.

The accident occurred after Thorne took off from Lockheed Air Terminal, Burbank, for Las Vegas. He climbed into an overcast, then followed an erratic course in which he reappeared below the overcast several times before the plane began to disintegrate and crashed about four miles southwest of the airport.

The Bonanza hit an apartment house, and Thorne and eight occupants of the building were killed.

The CAB found that Thorne lost control while climbing in the overcast and failed to recover full control during the subsequent maneuvers.

During the attempted recovery, the Board said, the Bonanza was subjected to forces beyond its design structural strength.

The CAB cited vertigo caused by the operation of rotating beacons as a factor in the loss of control. The report also listed numerous violations of air regulations, as well as an extensive record of motor vehicle violations, which it feels indicate that Thorne had "general disregard and disrespect for safe instrument flying practices and procedures."

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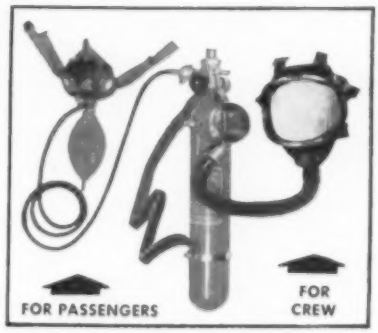

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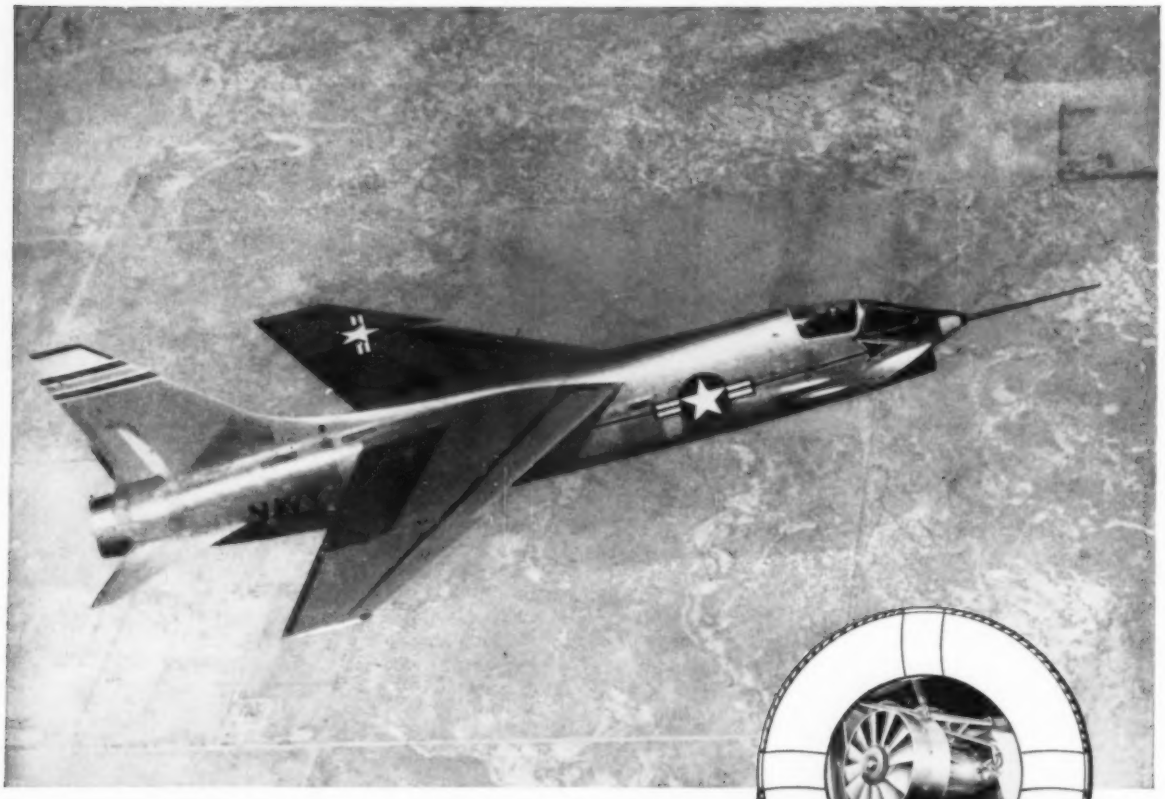

The Chance Vought F8U-1 Crusader, newest of the Navy's jet fighters, is equipped with a Marquardt ram-air emergency power package. In case of engine failure the unit pops into the air stream and supplies A-C, D-C, and hydraulic power sufficient to maintain flight control and communication through all speeds down to safe landing.

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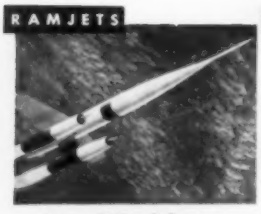
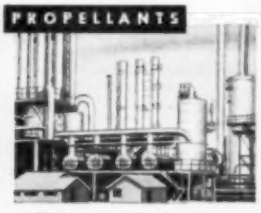


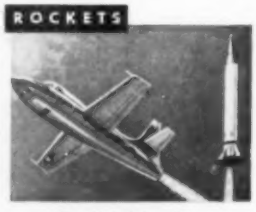
Marquardt Aircraft Company
Van Nuys, California

PROPELLANTS



Olin Mathieson Chemical Corp.
New York, New York

ROCKETS



Reaction Motors, Inc.
Denville, New Jersey

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Stock Transactions

Washington—Acquisition of 15,000 capital shares by Donald W. Douglas, officer and director of Douglas Aircraft Company, Inc., making a holding of 38,100 shares, is reported by the Securities and Exchange Commission. Other transactions for the period Jan. 11-Feb. 10 include:

Air Associates, Inc. Acquisition of 1,700 common shares by C. Kenneth Baxter, director, making a holding of 5,900.

American Airlines, Inc. Acquisition of 200 common shares by J. W. Farley, director, making an indirect holding of 500.

Bell Aircraft Corp. Disposal of 150 common shares by G. B. Clark, officer, his total holding; disposal of 200 common shares by William G. Gisel, officer, leaving a holding of 100.

California Eastern Aviation. Acquisition of 3,148 capital shares through exercise of option and disposal of 1,000 capital shares by Samuel J. Solomon, officer and director, leaving a holding of 37,805.

Capital Airlines, Inc. Disposal of 200 common shares by James B. Franklin, officer, leaving a holding of 4,000.

Chrysler Corp. Acquisition of 110 common shares through exercise of option by C. L. Jacobson, officer, making a holding of 1,508; acquisition of 400 common shares through exercise of option by C. J. Snyder, officer and director, making a holding of 760; acquisition of 200 common shares by L. A. Van Bomel, director, making a holding of 600.

Consolidated Electronics Industries Corp. Acquisition of 100 common shares by Horace M. Albright, director, his total holding.

Continental Air Lines, Inc. Acquisition of $23,000 of 4½% convertible sub debentures by Marco F. Hellman, director, making an indirect holding of $23,000.

Curtiss-Wright Corp. Acquisition of 1,000 common shares through exercise of option by James G. Byron, officer and director, making a holding of 1,200; acquisition of 1,000 common shares through exercise of option by Nicholas Dykstra, officer, making a holding of 1,200; acquisition of 1,500 common shares through exercise of option by Joseph V. Miccio, officer, making a holding of 1,600; acquisition of 200 common shares through exercise of option by M. E. Jordan Jr., officer, making a holding of 300.

Eastern Air Lines, Inc. Acquisition of 2,000 common shares by L. S. Rockefeller, director, making a holding of 90,000.

Emery Air Freight Corp. Disposal of 300 common shares by Leonard G. Hunt, officer and director, leaving a direct holding of 2,275 and an indirect holding of 1,932; acquisition of 400 common shares by James M. Mathes, director, making an indirect holding of 27,714.

Flying Tiger Line, Inc. Acquisition of 200 Class A common shares by John C. Cosgrove, director, making a holding of 500.

General Dynamics Corp. Disposal of 200 common shares by L. B. Richardson, officer and director, leaving a holding of 4,730; disposal of 800 common shares by Carleton Shugg, officer, leaving a holding of 6,350.

General Electric Co. Acquisition of 461 common shares by Walter R. G. Baker, officer, making a holding of 7,433; disposal of 160 common shares by C. J. Hendon, officer, leaving a holding of 1,415; acquisition of 2000 common shares through exercise of option by W. V. O'Brien, officer, making a holding of 2,807; disposal of 1,000 common shares by Philip D. Reed, director, leaving a holding of 4,300.

Goodyear Tire & Rubber. Disposal of 800 common shares by Harry W. Hillman, officer, leaving a holding of 1,648; acquisition of 6,490 common shares through exercise of option by P. E. H. Leroy, officer and director, making a holding of 12,400.

Lear, Inc. Acquisition of 295 common shares through bonus by H. C. Andrus, officer, making a holding of 1,298; acquisition of 160 common shares through bonus by F. D. Beamer, officer, making a holding of 166; acquisition of 306 common shares

Valve Talk

for WM. R. WHITTAKER CO., Ltd.

by Marvin Miles,
Senior Member, Aviation Writers Assn.

You could label it "Success Story," for at 33 Bernard (Barney) Maas is vice-president in charge of engineering for the Wm. R. Whittaker Co., Ltd.

His appointment to the position is in keeping with Whittaker's policy of assigning executive responsibility to younger men of proved engineering and administrative skill, men of vision, ingenuity and courage — and the type of quiet aggressiveness that blends these factors into the achievements of modern technology.

Soft-voiced, a man with a good grin, Barney likes music, plays the piano, goes in for golf, but from his rugged physique you get the idea of athletic training somewhere along the line. And you're right — boxing and wrestling in college.

Educated at UCLA and the University of California at Berkeley, he worked as a Lockheed draftsman and in the Cal test labs while he was still in school. In World War II he served as skipper aboard a Navy minesweeper.

Bernard (Barney) Maas

Graduated as a mechanical engineer, Barney went to work for AiResearch, starting in process engineering, moving to the design engineering group and rising to Project Engineer for Pneumatic Controls.

His abilities carried him into virtually every stage of development engineering, and he headed design groups for flow, pressure and temperature controls, pressure ratio and speed units, shut-off valves, etc., covering a period of about ten years.

Barney came to Whittaker from the AiResearch plant in Phoenix to succeed Joe Globig who was elected president of Whittaker Gyro after five years as vice-president of engineering for the Wm. R. Whittaker Co., Ltd.

His responsibilities are primarily of an administrative and organizational nature — but nevertheless, responsibilities that could never be met without a wealth of technical know-how.

His engineering department covers the four major fields of pneumatics, fuel, hydraulics and electrical components, and includes 178 engineers, 83 inspection personnel, 71 assembly workers forming units not yet ready for production, and 24 maintenance men.

Barney and his staffers work closely with Field Engineering, headed by Vice-President Glenn Whitaker, and once the requests and specs are in on a proposed job, it is his responsibility to evaluate the project, consider design approaches, decide whether a particular job is feasible engineering-wise, determine test requirements, figure price range, time and materials involved, and make technical assignments once the company decides to go ahead with the project.

"It's a matter of keeping ahead of yourself," he explains. "You've got to anticipate what you'll be facing six months from now, a year from now or even later. Take test equipment, for instance. Due to the ever increasing conditions of pressure, temperature, altitude and reliability, engineering could end up with design requirements for urgently needed new products and have no way to prove it out."

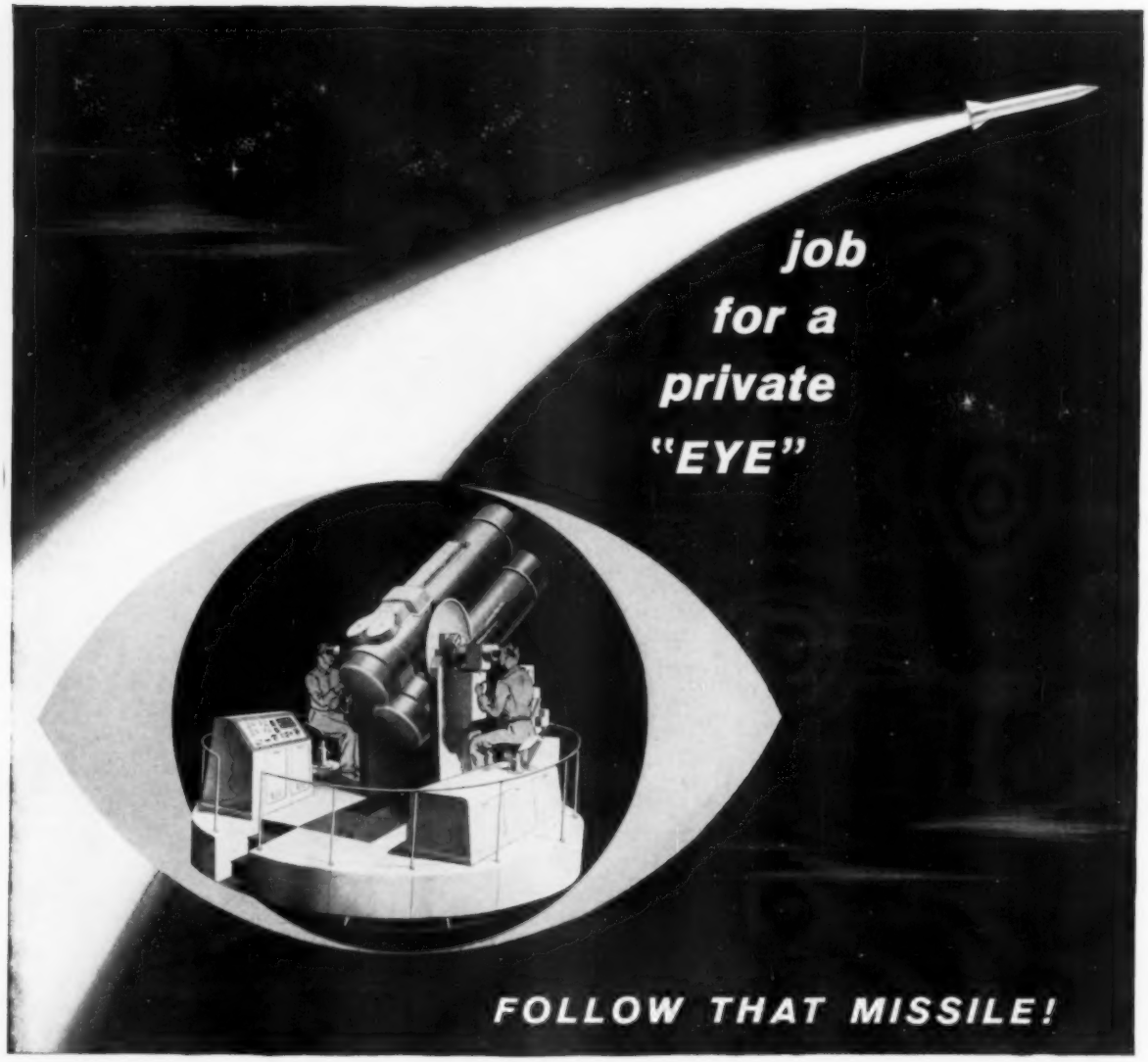
Barney also must function constantly as an efficiency expert, analyzing methods of operation within the engineering department day by day to assure the utmost achievement. And he must also battle paper work, the flooding grist of the paper mill that paces a company like Whittaker with between 400 to 500 different design items in production constantly, in addition to components.

Barney is sold on Whittaker and its future.

"I wouldn't be here otherwise," he grins.

He likes the challenge of the aircraft accessory business and the chance to help build the company in the ring of constant competition. He follows trends through the twin-lens microscope of understanding and vision, and he can talk for hours on the problems of the future — on soaring speeds and altitudes, ever-widening temperature ranges, on system design and miniaturization, on increasing severity in requirements and design criteria parameters.

"Of one thing you can be sure," he says. "This business is never static. Whittaker designs and builds comparatively small quantities of many different designs. Customer requirements change constantly and we are in business to meet their needs."



Tailing an experimental missile in flight takes a special kind of "eye." Seconds after takeoff the missile has kicked through the sound barrier and receded to a fast-moving speck that registers no larger than a few thousandths of an inch in a telescopic field.

To help the Air Force track its missiles, Perkin-Elmer has developed ROTI Mark I (Recording Optical Tracking Instrument). ROTI provides an accurate photographic and magnetic tape record of the missile's flight. ROTI consists of twin 16″ aperture telescopes having a range of 7 focal lengths from 50-500 inches, mounted on a large naval gun mount. When used in pairs, it records a missile's spatial position as a function of time with phenomenal accuracy. Velocity, acceleration and attitude can be derived for aerodynamic analysis.

ROTI is more than a precision instrument—it is a complex optical and electro-mechanical system. It was designed and built by an engineering staff with the technical scope and experience to take a systems problem and "see it whole."

Outstanding equipment developed and produced by Perkin-Elmer:

- **the Y-4 Bombing Periscope for the B-47**
- **prototype optical and radar bombing and navigation system now designated MA-2 for use on the B-52**
- **most large aerial photographic lenses in use today by the Air Force**
- **reactor periscopes for the Nautilus and Seawolf submarines**
- **airborne infrared detection systems for military use — these are the real "private eyes" from the security standpoint.**

In planning your next project, invite Perkin-Elmer to sit in. Our unique staff and facilities can bring your project to fulfillment sooner than you may now realize.

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North American Aviation, Inc., is doing research and development on a manned aircraft, the X-15, for investigation of high-altitude, speeds and temperatures.

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Opportunities in our other engineering departments offer you a wide scope for your talents at North American. Enjoy the individualism and team spirit we offer. Work with engineers who respect your opinions and professional status. Check over our list of openings below and get in touch with us. It will be well worth your inquiry.

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Flutter Aeroelastic and flutter analysis now being conducted on current and advanced designs of supersonic airplanes. Experience and capability in independent flutter analysis projects required. Advanced degree desired, but not necessary for man with adequate background.

Electronics Analog and Digital computer experience required. Formulate and solve aeroelastic problems. B.S. degree desired.

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through bonus by Albus Durham, officer, making a holding of 562; acquisition of 466 common shares through bonus by Philip E. Golde, officer, making a holding of 13,075; acquisition of 427 common shares through bonus by A. G. Handschumacher, officer, making a holding of 1,823; acquisition of 1,000 common shares through exercise of option and acquisition of 169 common shares through bonus by Albert C. Keske, officer, making a holding of 1,407; acquisition of 1,067 common shares through bonus by William P. Lear, director and beneficiary, making a holding of 418,242; acquisition of 705 common shares through bonus by Richard M. Mock, officer, making a holding of 16,860; acquisition of 291 common shares through bonus by Paul Moore, officer, making a holding of 604; acquisition of 148 common shares through bonus by Albert A. Rorison, officer, making a holding of 263; acquisition of 168 common shares through bonus by Chester D. Seftenberg, officer, making a holding of 271.

Minneapolis-Honeywell Regulator Co. Disposal of 800 common shares by Richard P. Brown, director, leaving a holding of 74,197; disposal of 200 common shares by John J. Wilson, officer and director, leaving a holding of 90,700.

Northwest Airlines Inc. Disposal of 600 shares of 4.6% cumulative convertible preferred by Malcolm S. Mackay, officer and director, leaving a holding of 1,400.

Northrop Aircraft, Inc. Disposal of 300 common shares by John O'Melveny, director, leaving a holding of 342.

Pan American World Airways, Inc. Acquisition of 750 common shares through exercise of option by Alvin P. Adams, officer, making a holding of 1,709; acquisition of 1,250 common shares through exercise of option by Erwin Balluder, officer, making a holding of 17,985; acquisition of 1,750 common shares through exercise of option by R. G. Ferguson, officer, making a holding of 2,384; acquisition of 1,000 common shares through exercise of option by Franklin Gledhill, officer and director, making a holding of 4,627; acquisition of 1,000 common shares through exercise of option by Harold E. Gray, officer, making a holding of 5,189; acquisition of 375 common shares through exercise of option by R. S. Mitchell, officer, making a holding of 797; acquisition of 3,750 common shares through exercise of option by Wilbur L. Morrison, officer, making a holding of 11,962; acquisition of 1,875 common shares through exercise of option by Samuel F. Pryor, officer and director, making a holding of 10,107.

Ryan Aeronautical Co. Acquisition of 100 common shares by Emtor, Inc., beneficiary, making a holding of 87,500.

Seaboard & Western Airlines, Inc. Disposal of 200 common shares by Douglas M. Amann, director, leaving a holding of 7,016.

Sperry Rand Corp. Acquisition of 27,300 common shares by K. R. Herman, officer and director, his total holding.

Trans World Airlines, Inc. Disposal of 1,000 common shares by Warren Lee Pierson, officer and director, leaving a holding of 1,990.

United Air Lines, Inc. Acquisition of 100 common shares by Martin C. Ansorge, director, making a holding of 600; disposal of 968 common shares by John A. Herlihy, officer and director, leaving a direct holding of 2,000 and an indirect holding of 54.

United Aircraft Corp. Acquisition of 110 common shares and disposal of 63 shares of preference 4% series by Harry G. Stoddard, director, making a holding of 1,370 common shares.

Western Air Lines, Inc. Disposal of 1,200 common shares by C. J. J. Cox, officer, leaving a holding of 1,750; disposal of 500 common shares by Terrell C. Drinkwater, officer and director, leaving a holding of 5,000; disposal of 200 common shares by J. J. Taylor, officer and director, leaving a holding of 1,850.

Westinghouse Air Brake. Acquisition of 1,000 common shares by R. O. Yearick, officer and director, making a holding of 1,526.

Westinghouse Electric Corp. Acquisition of 300 common shares by Edward O. Boshell, director, making a holding of 400; acquisition of 100 common shares by Edward Hopkinson Jr., director, making a holding of 200; acquisition of 100 common shares by Robinson S. Kersh, officer, making a holding of 660; acquisition of 100 common shares by Arthur W. Page, director, making a holding of 260; acquisition of 300 common shares by A. W. Robertson, director, making a holding of 500.

Vertol Aircraft Asks Ouster of Piasecki

Nine of the 12 directors of Vertol Aircraft Corp. have approved an amendment to the by-laws which would mean the unseating of the other three—Frank N. Piasecki, president; Donald N. Meyers, vice president; and James J. Davis, who serves as company secretary and counsel.

The proposed amendment, scheduled to be voted on at a special meeting of shareholders on Apr. 5, would ban the service of directors with interests in competing companies. Piasecki, Meyers and Davis are officers and directors of Piasecki Aircraft Corp., formed last June.

On Mar. 9 the name of Piasecki Helicopter Corp. was officially changed to Vertol.

In a letter to shareholders, Don R. Berlin, chairman and president of Vertol, declared that the three officers and directors of Piasecki Aircraft "cannot meet the standards of loyalty to your company."

He said that Piasecki Aircraft "is engaged in the same fields of endeavor as your company and in fact is competing with it."

Royal

AMPHIBIAN NEWS

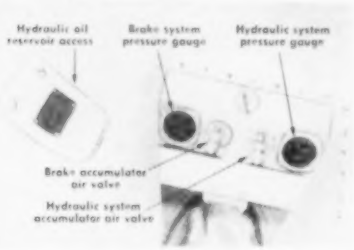
Notes on America's outstanding utility amphibian for business flying and charter service operation

AMPHIBIAN DESIGN OF ROYAL GULL ELIMINATES WHEEL AND BRAKE TROUBLES

LANDING GEAR RIDES HIGH AND DRY — A feature typifying the Gull's highly functional design is the way the wheels are almost fully recessed, well above the waterline — even when the plane is fully loaded. And they're clear of all but minor spray as hull configuration precludes "porpoising." Positive locking (both up and down) landing gear has both mechanical and electrical position indicators for added safety.

SPECIALLY-DESIGNED BRAKES, SEALED WHEEL BEARINGS — Hydraulic-actuated brakes (standard for both left and right hand pilot seats) won't slip, grab or chatter — even when wet! Wheel bearings are sealed against moisture . . . need only normal lubrication and maintenance checks. Note sturdy construction of entire landing gear assembly. Tires are standard U. S. sizes.

EASY OUTSIDE ACCESS TO ACCUMULATORS — Brake and main hydraulic system accumulators plus oil reservoir are charged externally, have direct reading gauges, are located in the wheel well. Make positive pre-flight checking easy!


Hydraulic oil reservoir access
Brake system pressure gauge
Hydraulic system pressure gauge
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Hydraulic system accumulator air valve

These are only a few of the many outstanding operating and maintenance simplifying features. To get the complete story on why the Royal Gull is truly America's most modern and efficient 5 place amphibian for executive or charter service, fill out and mail the coupon at right.

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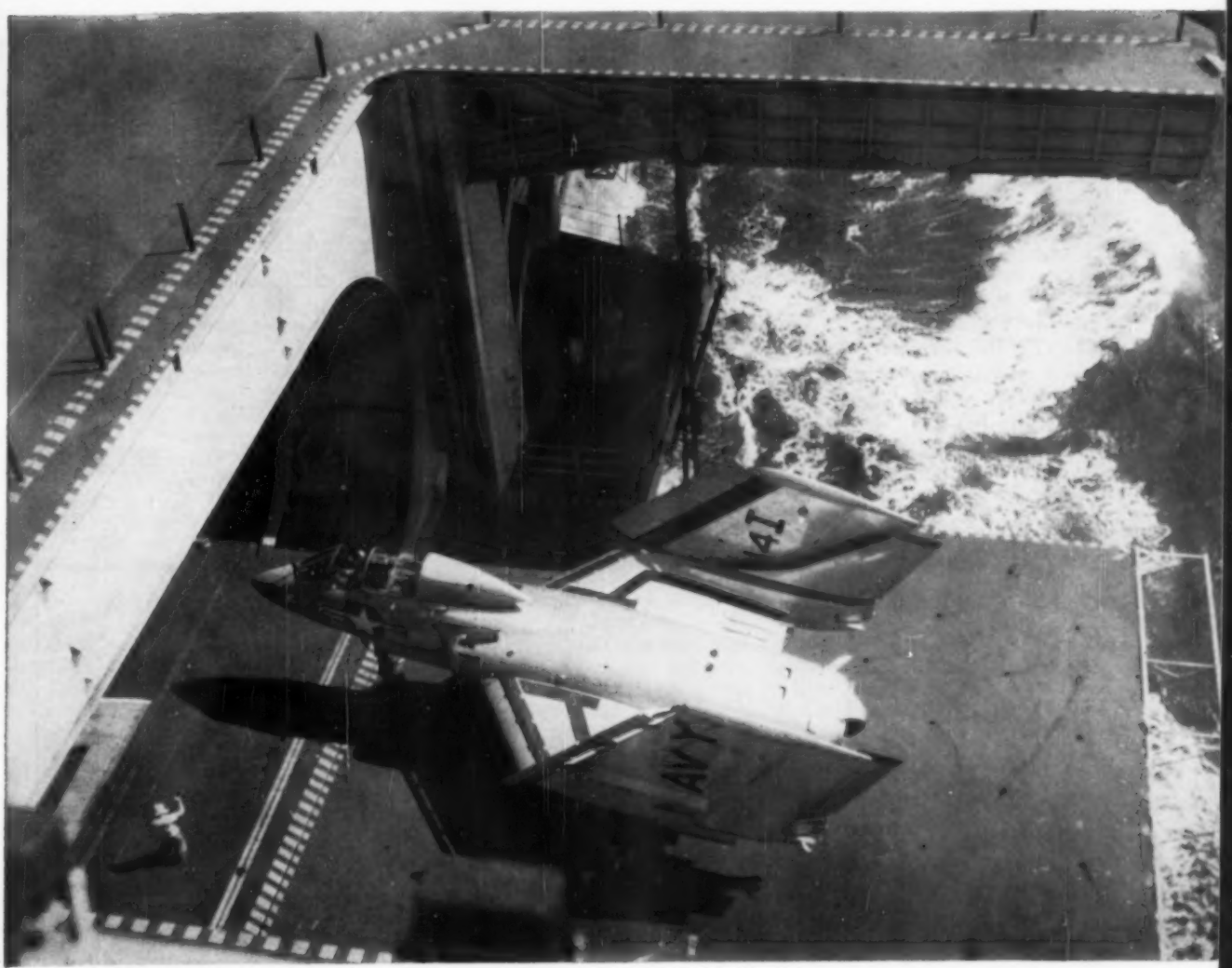
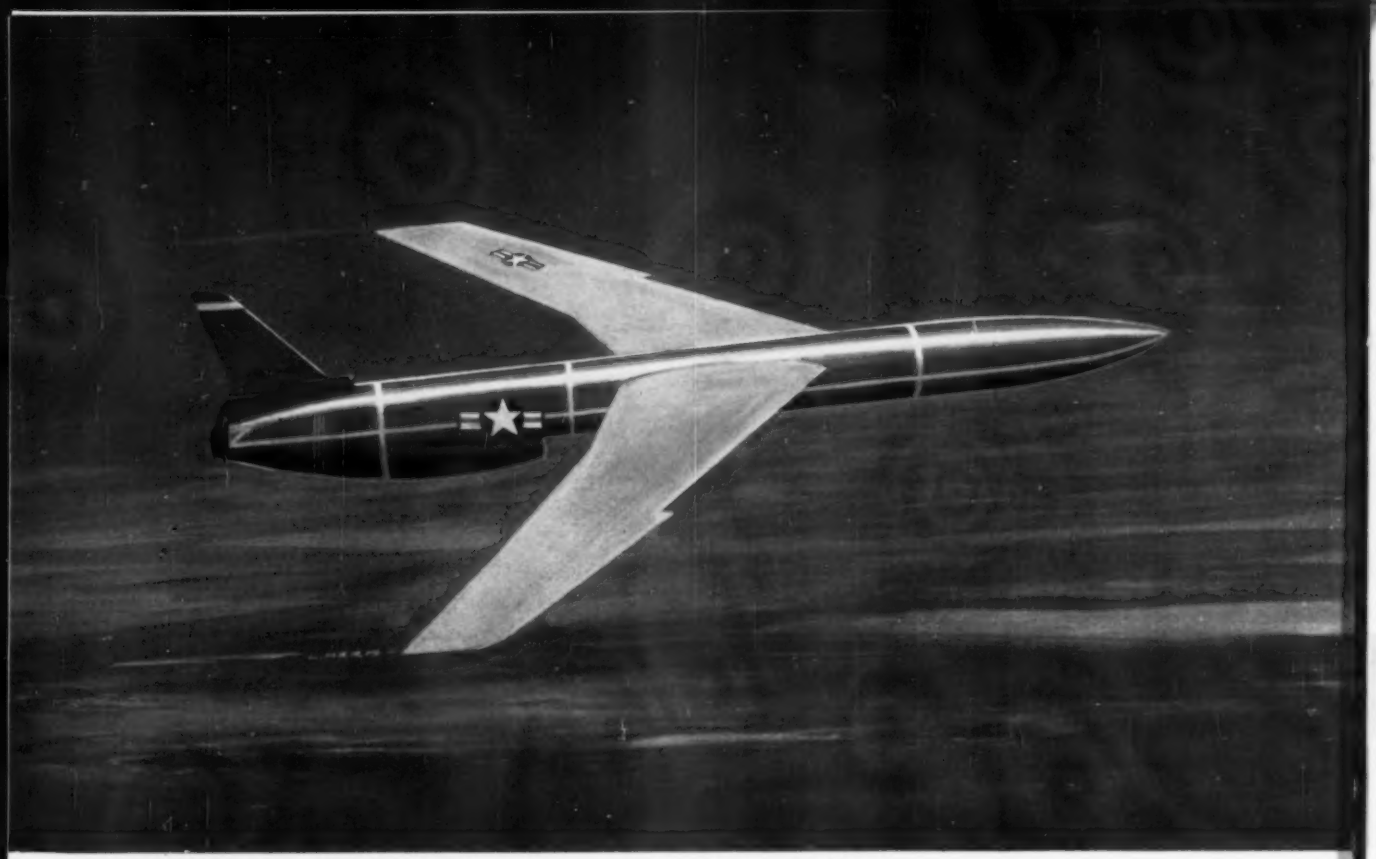
USS Forrestal Gets Its Wings

The USS Forrestal steamed through the warm waters off Cuba earlier this month, giving its powerful sea-legs their first real test and receiving its wings from some of the aircraft that will follow it into operational duty. In picture on left, Forrestal deck is patterned by a Piasecki HUP-2 helicopter, McDonnell F2H Banshees, North American FJ-3 Furies and Douglas AD Skyraiders in background. Below left, an FJ-3 is hurled down deck by steam catapult as two others await their turn and then comes back again in picture above. Below, a crewman positions a Chance Vought F7U on the elevator for a ride up to the flight deck.





INTERCONTINENTAL SNARK MISSILE in flight as conceived by Aviation Week's artist.

Snark Design Stresses Range, Simplicity

By David A. Anderton

The only available U. S. guided missile with intercontinental range capability is the Northrop Snark SM-62, a tailless, turbojet-powered weapon that cruises at high subsonic speed.

Into its 60-ft. fuselage, Snark packs a nuclear warhead and enough fuel to match the striking radius of strategic jet bombers.

Many firings of the complete Snark aerial delivery system have been made at the Air Force Missile Test Center, Patrick AFB, Fla. These flight tests, plus an intensive development program using conventional aircraft, have underscored the accuracy of the Northrop-developed Mk. 1 "hybrid" inertial guidance system, which incorporates star-tracking.

The Snark was one of three missiles referred to recently by Secretary of the Air Force Donald A. Quarles, who said the missile was in a pre-production status. Northrop's main plant at Hawthorne, Calif., has been manufacturing limited quantities for at least five years.

Production Missile?

Biggest current argument about the Snark is whether or not it should be placed in high-volume production. The subsonic-speed formula, to which Snark was designed almost ten years ago, has lately been rejected by USAF top planners who say they don't want any more subsonic delivery systems.

But proponents of the Snark formula point to continuing USAF orders for subsonic long-range bombers and cite figures to prove that Snark can do a comparable job at far lower cost per operation. They say Snark requires no aerial tanker fleet and much less logistic support. It can be placed in large-scale production at very low cost—approximately 5% of the equivalent long-range bomber.

Ground facilities are much less expensive, they add. Early Snarks were launched from a rocket-powered sled running on a highspeed track; Northrop developed the idea and later went on to build similar sleds for aero-medical and equipment tests at high speeds on the ground. Late models of Snark are believed to use zero-length launchers, like the operational Martin Matador TM-61A and -61B tactical missiles.

Most telling argument, say the Snark backers, is the almost-immediate availability of the missile and navigational system.

Advanced cruise-type missiles, such as the North American Navaho, are some years off, although test vehicles powered by interim engines are on development flight status. Intercontinental-range ballistic missiles, crash

Snark vs. ICBM

"The intercontinental ballistic missile is a fearful weapon. It is not, however, the complete answer, in our opinion. We feel there is still an important defense job for the high-speed cruise type missile like the Snark, which is relatively simple and inexpensive, and flexible enough to be used in a variety of ways over a variety of ranges. . . . We are glad that at this point in time, as far as we know, the Soviets do not have anything like it."—Whitley C. Collins, president of Northrop Aircraft, Inc. in a statement before a House Armed Services Subcommittee.

programmed or not, are even further off.

Basic characteristics of the Snark were roughed out publicly by John K. Northrop in 1947 for the President's Air Policy Commission: ". . . Know-how is presently available for the design of a 600-mile per hour missile with a range of 4,000 miles or better, which can be built at a reasonable price, and which is suitable for mass production methods in shadow factory organizations."

Snark Geometry

The tailless layout of Snark is built around a high aspect ratio wing swept back at 45 degrees. To the basic aerodynamic lines of the wing have been added a leading-edge extension from the mid-span outboard and a trailing-edge filler which increases the root chord. Wing leading-edge inboard section is cambered.

The vertical tail is swept to match the wing and is high with a narrow chord.

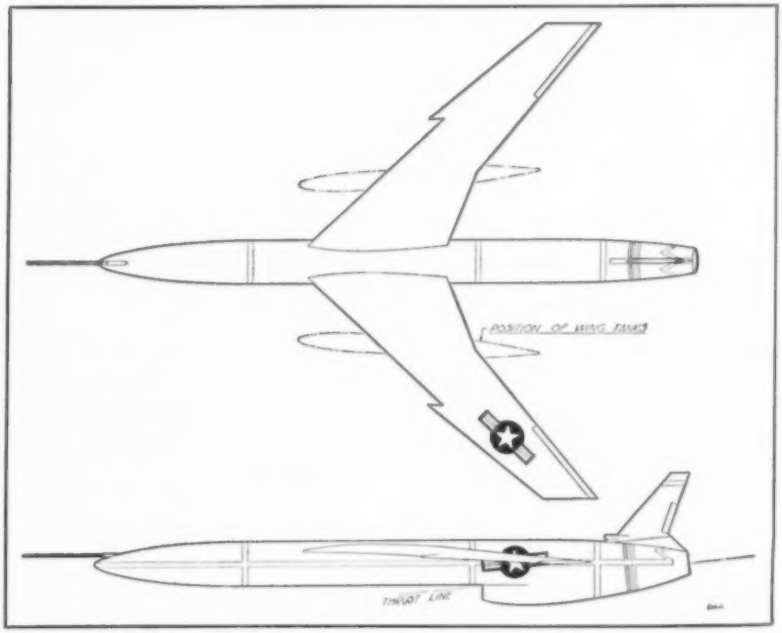
The Snark fuselage, which houses powerplant, fuel, guidance equipment and warhead, is egg-shaped in section. The Allison J71 turbojet is mounted near the tail and is fed from an underslung belly duct.

Fuel is carried in the fuselage and in a pair of wing tanks mounted inboard of the leading-edge extension and angled nose-in toward the fuselage to match the local airflow streamlines. Automatic fuel transfer among the tanks maintains acceptable center-of-gravity position.

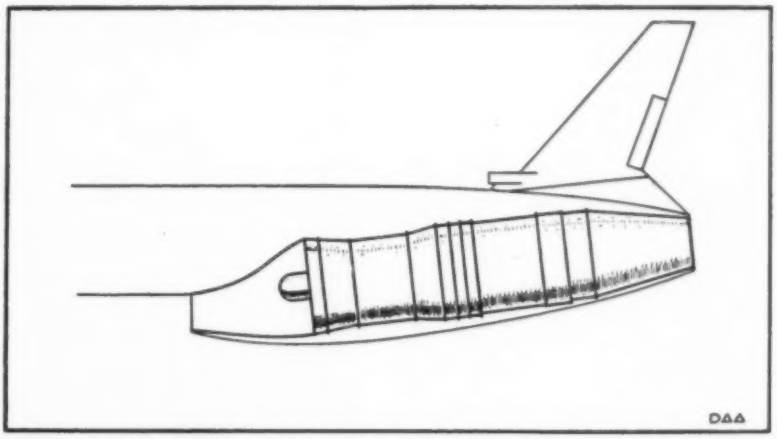
The Snark's flight path is the conventional one of the subsonic cruise missile. After launching, it climbs to altitude and cruises at approximately Mach 0.9, at the fairly high angle of attack that is characteristic of tailless aircraft.

During its constant-speed cruise flight, Snark gains altitude as the gross weight is reduced by fuel consumption. Near the target, Snark pushes over into a terminal dive to destruction.

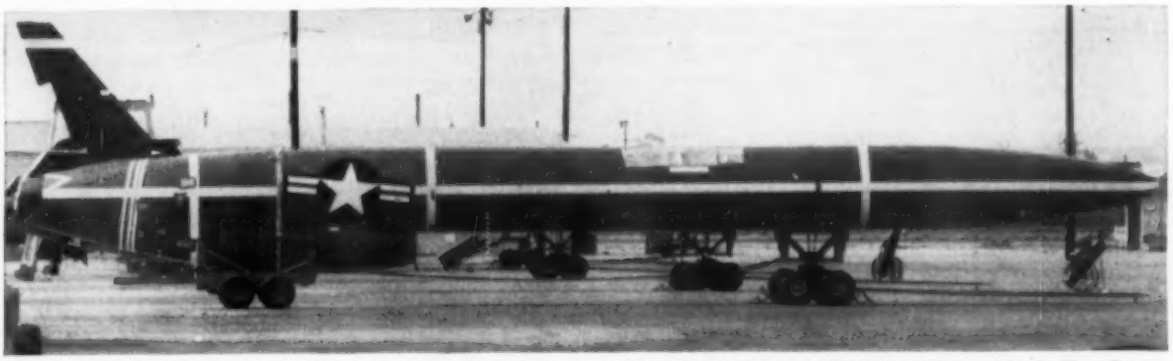
During cruise, Snark's vulnerability



SNARK PLAN AND SIDEVIEW are approximated in these drawings.



PROBABLE INSTALLATION of Allison J71 engine in Snark.



SNARK MISSILE without wings and movable tail. Lines on fuselage aid in flight testing at USAF Long Range Missile Test Center.

to enemy attack is not high. Its speed, size and altitude would place it beyond effective range of conventional anti-aircraft defenses. It would be a tough, but not impossible, target for surface-to-air missiles, but those missiles would have to be much more advanced than the contemporary Nike or Terrier. Biggest disadvantage is the straight-line flight of Snark, which makes target prediction easy for enemy detection systems. But an evasive flight path could be programmed for the final run to the target.

Cost and Range

Two basic factors dominated the development of the Snark: maximum range and minimum cost. The first dictated the inevitable aerodynamic compromise that made the Snark a tailless, sweptwing configuration. The second dictated the layout and detail design of the airframe.

The range for a cruise-type missile can be approximated from the classical Breguet equation: Range is directly proportional to true airspeed, lift-drag ratio and the natural logarithm of the ratio of initial to final weight. It is inversely proportional to the specific fuel consumption.

That formula shows the possible ways to maximize range. Aerodynamically, the only two terms affected are the airspeed and the lift-drag ratio. Weight ratio is a structural term, and powerplant performance defines the remaining term of specific fuel consumption.

Product of Mach number and lift-drag ratio must be a maximum for a given missile in order to realize maximum range potential. But both lift and drag are functions of Mach number; the maximum lift-drag ratio decreases rapidly at critical Mach number because of drag rise.

The best aerodynamic wing is thin and swept: the best structural wing is thick and straight. That's an oversimplification, but it emphasizes the extremes of both types. Thus, the final choice of sweepback and thickness is a compromise between aerodynamics and structures.

If the wing thickness and aspect ratio are fixed by structural reasons, then the product of Mach number and lift-drag ratio increases as wing sweep increases. This is because local reduction in wing peak suction pressures increases the critical Mach number faster than the shortening of the span reduces the lift-drag ratio.

But as sweep increases, the torsional loads on the wing root increases, and this means more structural weight. That increase reduces the weight ratio term in the range equation.

Northrop's best compromise solution, based on the extent of aerodynamic and structural knowledge at the time, was a 45-degree sweep, highest of any aircraft then projected.

WING SECTION cast in single piece from magnesium. Northrop pioneered structural developments for Snark intercontinental missile.

There was a further advantage of such sweep with a high aspect-ratio wing: wingtip controls could be used for both roll and pitch, eliminating the horizontal tail.

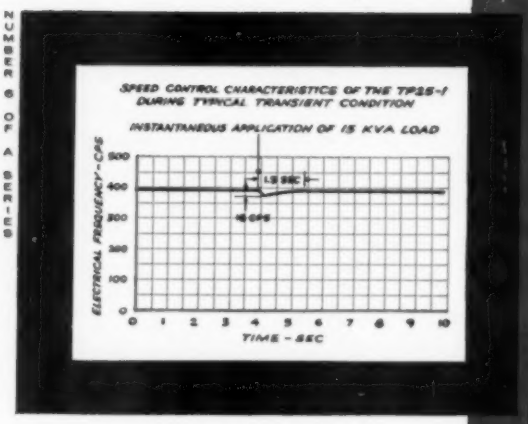
Two Sets of Troubles

Northrop engineers must have been aware of the price that might have to be paid for selecting such an aerodynamic geometry. In general, two types of troubles have risen to plague designers of highly swept, high aspect ratio wings:

- **Aeroelastic effects,** caused by the flexibility of the structure under torsional loads.

That flexibility reduces control effectiveness—sometimes to the point of reversal—and cuts down longitudinal stability.

- **Pitch-up,** caused by the stalling of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Designed specifically for operation in high performance aircraft the TP25 functions with bleed air inlet temperatures of 900° F at inlet pressures over 450" HgA, ambient temperatures of 250° F and cooling air temperatures of 210° F. It is not altitude limited, operating to the service ceiling of the new aircraft in which it is installed.

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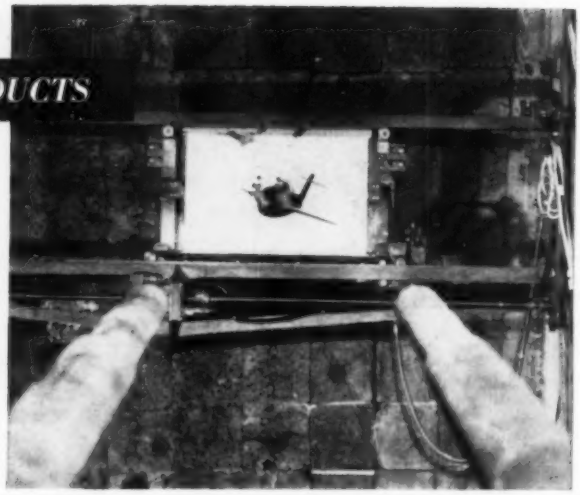


Problem: To cut armament system development time

Solution: New G-E DYNAT reduces need for flight test.

DYNAT—that's the name General Electric gives to its new Dynamic Accuracy Tester which can now evaluate complete airborne armament systems during ground firing under fully simulated flight conditions.

Combat readiness of airborne armament systems can be evaluated only by complete testing; so extensive flight tests are necessary to duplicate actual armament system environmental conditions. This procedure is expensive, time consuming and gives only a sampling of a system's performance. DYNAT solves this testing problem by simulating on the ground the situations expected in aerial combat. In this way Dynat saves time and money and gives a complete evaluation under all conditions required for combat readiness.

General Electric believes it has the answer to this problem with DYNAT; here's why:

1. Simulates air battles on the ground
DYNAT can be used for complete armament system and component evaluation. It tests the actual radar tracking and actual gun firing errors while the computing system is functioning. It consists of a group of units designed to simulate the duel conditions and provide continuous evaluation records of the problems that an armament system meets during the actual duels.

2. Tests effects of own ship's motion
DYNAT tests the ability of the armament system to compensate for its own ship's motion.

3. Radar noise
DYNAT can test the effects of radar noise, either atmospheric, system, or target generated.

4. Shock and vibration testing
DYNAT can test the effects of ship's vibration, shock, and any other circuit noise that might be encountered in actual flight firing.

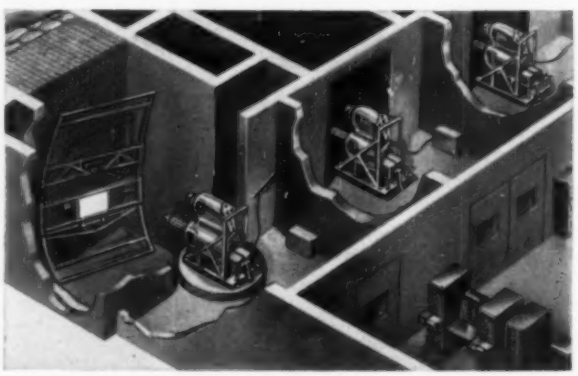
5. Windload effects
Windload conditions on the armament system with DYNAT can be simulated with weights and shock cords such that the proper load is applied to the weapon for a given angle of firing and condition of flight.

6. Complete environmental testing
Installation of DYNAT in G.E.'s all-angle firing lane permits full firing evaluation at any temperature from −100 F to +160 F.

DYNAT SIMULATES ACTUAL FLIGHT.
Every flight condition can be simulated by DYNAT. The fire control system tracks, computes, and *fires* in an environment which closely approximates its operational habitat; the effect on the armament system can then be evaluated through DYNAT. DYNAT results can then be checked airborne by flying only a fraction of the flights required on present full-scale airborne tests. The fact that DYNAT can simulate actual flight tests relatively quickly and inexpensively will permit the accumulation of statistical data from a far greater number of simulated air-duel courses than is normally possible in actual flight testing.

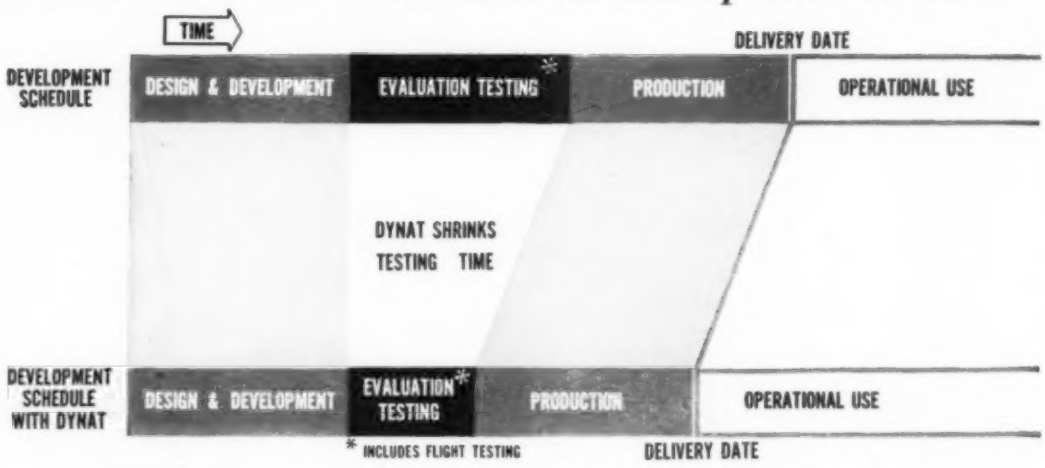
For more information on DYNAT, contact your nearest G-E Apparatus Sales representative, or write for bulletin GEA-6345, General Electric Company, Section 210-99, 1 River Road, Schenectady, N. Y.

DYNAT control console records both correct answers to attack problem and armament system's computed solution.



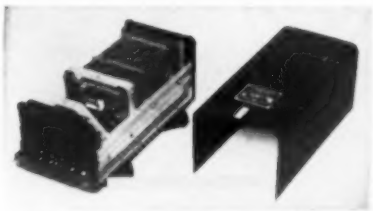
Foreground shows General Electric's all-angle firing lane with DYNAT installed. Console is in outer control room.

Here's how DYNAT reduces over-all development schedule



DYNAT's ability to reduce evaluation testing time will help to get operational systems in service sooner.

G-E Transformer-Rectifier operates at higher ambient temperatures



Weight of new unit is only 23.5 lbs.

General Electric's latest addition to a new line of transformer-rectifiers is model 6RS705F2. Weighing only 23.5 pounds, it actually betters the demands of MIL-P-7212 requirements. It can operate without derating up to 60,000 ft. at 20 C, or at sea level up to 110 C. A 5 KW unregulated unit for use in missile applications has also been developed, weighing 32.5 lbs. and a new design of a 12 amp. (4½ lbs.) unit has been completed.

OTHER DESIGNS AVAILABLE.

Many designs are available along with application engineering services on new and very special units, including units without built-in cooling means which can be utilized with blast cooling furnished. Silver-zinc battery charging tests have been made on the 200 amp regulated units, and test reports are available on request.

Latest G-E developments indicate that an 18 lb., 100 amp unregulated unit is now possible (MIL-P-7212), and a 55 lb., 200 amp regulated unit is in the immediate future. To reduce weight of regulated units, new circuit developments are being investigated such as the use of zener diode reference circuits and ampliformers. Use of Silicon broad area rectifiers is under study.

General Electric has done pioneer work in reducing size and weight of regulated and unregulated airborne power supplies. Check your nearest G-E Apparatus Sales representative for further information, or write for bulletin GEA-6413, Section 210-99, General Electric Co., Schenectady 5, New York.

New servo motor operating on B-47

Developed as part of a servo mechanism in the gun directional computer system for the B-47, General Electric's new miniature d-c aircraft motor is but 1⅝ inches in diameter. Weighing 8 ounces, it operates equally well at sea level or at 50,000 ft. provided the ambient at altitude is at the lower end of the temperature range as stated in the general motor specifications.

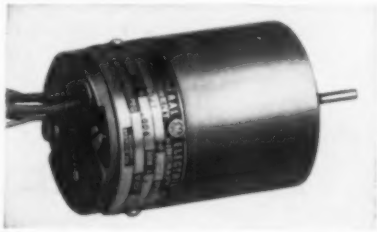
DESIGNED FOR THESE APPLICATIONS

The new motor is designed to meet the intent of the military specification MIL-M-8609 (ASG), and the extreme environmental conditions of this spec for short periods of time. It can be used as a prime mover in a gun directional computer system, in electronic devices, and can be modified for other aircraft and missile applications requiring a reversible motor capable of giving a high speed of response. It can also be geared to very low speeds where applications dictate.

NEW MOTOR HAS THESE FEATURES

Rated at 0.002 hp at 6500 rpm, the new, miniature d-c motor is built with Nicalloy punchings and pole pieces to meet the rigid humidity requirements given in the specifications. It is not restricted to any one type of operation, but has the advantage of a small time constant and good efficiencies in applications where small power outputs are required.

For further information on this new motor check your nearest G-E Apparatus Sales representative or write for bulletin GEA-6314, Section 210-99, General Electric Co., Schenectady, New York.



G-E servo motor is used in B-47 gun directional computer system.

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For complete technical information on the PHILCO SB Transistor

write to: **LANSDALE TUBE COMPANY**
A Division of PHILCO CORPORATION
LANSDALE, PENNA.

PHILCO CORPORATION

LANSDALE TUBE COMPANY, DIVISION
LANSDALE, PENNSYLVANIA

the wingtips first; the resulting lift distribution gives a violent nose-up pitching motion at lift coefficients above that for maximum lift-drag ratio but below maximum lift.

The lack of a horizontal tail has its disadvantages, also two in number:

• **Reduction in pitch control** and damping because of the elimination of the tail surface at the end of its long moment arm.

• **Trim drag,** produced because the tailless airplane tends to trim at higher angles of attack for a given flight condition than do its tailed brothers.

Pitch-up appears to have been cured by the use of the leading-edge extension, which generates a vortex to re-energize the boundary layer near the tip to prevent breakaway. In addition, the trailing-edge filler moves the center of pressure aft at the root, so that when the tip does stall, the center of pressure is not so far forward and the pitching is not violent. Wing leading edge inboard is cambered as an extra help.

For trim drag, there is no cure, except to use a horizontal tail; this is one of the troubles that the designers of the Snark—and the Douglas F4D and Convair F-102—have had to live with. Some indication of the cruise angle of attack can be seen in the side view of Snark; the thrust line and the centerline of the insignia are horizontal in level flight.

Moment arm of the Snark's "tail"—which are its wingtip elevons—is not much shorter than if the missile had a conventional surface.

Snark Structure

Field operations of missile systems call for delivery of the weapon in interchangeable subassemblies with simple connections.

Delivered Snarks follow the same pattern as the Martin Matador: they arrive in the field in several large component sections. Size of Snark suggests that the fuselage is shipped in at least three sections—forward nose, central fuel bay and tail powerplant. Height of the vertical tail assembly dictates that it be shipped separately and attached at the firing point. Wing panels also attach at the launching site.

Details of Snark structure have not been released; but Northrop interest in several areas of structural development indicate some of the possibilities:

• **Experimental cast magnesium wing** was produced by the company (AW). Largest magnesium casting produced at the time, the unidentified panel was of a size and shape that could only have been a Snark outer panel. It was fabricated as one of several alternate methods of wing construction, and studied in contrast to the more conventional multi-spar 75 ST makeup.

• **Foamed-in-place plastics** have been used by Northrop in small sections; one of the possible applications for such material would be in fabricating the constant-chord control surfaces of Snark.

• **Sandwich materials,** which are natural choices for such kinds of structures as cargo floors and aircraft bulkheads, are another Northrop technique. One prospective use would be in the bulkheads of Snark.

All units are designed for easy assembly in the field; quick-disconnects are used for all interconnected systems.

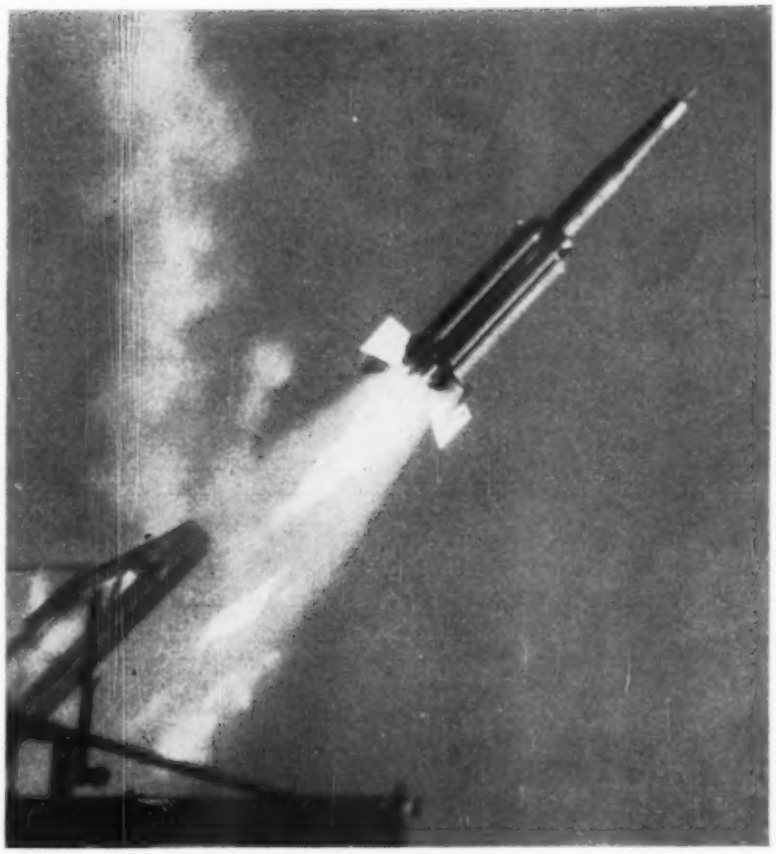
Test Program

Northrop's test program with the Snark probably followed the typical pattern of development, including wind tunnel and free-flight models. It used a number of aerodynamic test vehicles—Snarks without guidance—for determining the basic airframe and systems characteristics before marrying them to the guidance system. Paralleling this airframe program was extensive flight-test development of the guidance system, which first flew in a converted Northrop P-61 Black Widow night fighter. Many hands-off flights were made in the Widow and in later aircraft more representative of Snark before the Mk. 1 was released for flight in a missile.

Early flights of Snark airframes were made at Holloman Air Development Center, controlled by command guidance links from mother aircraft. After Snark became a prototype weapon system, complete with its navigation, flight tests were transferred to AFMTC at Cocoa, Fla.

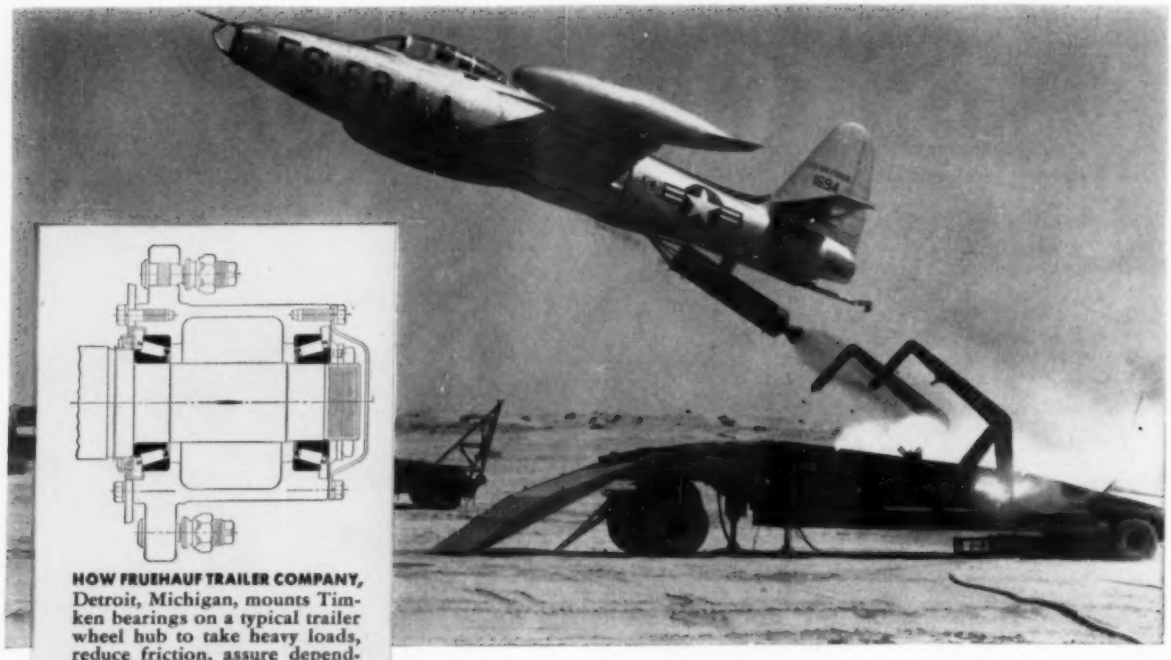
The number of flights made there has led the area between Cape Canaveral and the down-range islands to be dubbed "Snark-infested waters" by some missile wags. It is true that a number of Snarks were dumped during the program, but frequency decreased as the program continued. Current loss rate due to troubles after launching is very low.

Next step for the Snark will be determined by the production decision. If the Air Force decided to make the SM-62 its first long-range pilotless bomber, then USAF training groups can start to get the missile within a relatively short time after the decision.



Napier Test Missile

Ramjet test missile developed by Napier has reached heights "greater than any similar British Missile." It was destroyed while still climbing to avert danger to shipping. Test missile is integral ramjet device, about 17 to 20 ft. long.



HOW FRUEHAUF TRAILER COMPANY, Detroit, Michigan, mounts Timken bearings on a typical trailer wheel hub to take heavy loads, reduce friction, assure dependable performance.

35,000-pound airport rolls on TIMKEN® bearings

TO make possible launching jet fighters and missiles without runways, Fruehauf built the new "Zero-Length" semitrailer for Martin, Baltimore. And to be sure the wheels and axles could take the 35,000-lb. trailer load *plus* the weight of the plane or missile, Fruehauf engineers specified Timken® tapered roller bearings for the wheel mountings.

Timken bearings take *both* radial and thrust loads in any combination. Their tapered construction does it. And full line contact between their rollers and races gives Timken bearings extra load-carrying capacity. The trailer wheels roll easily on Timken bearings. Need no special devices to take the heavy thrust loads of turning.

Wear and maintenance are cut, longer bearing life assured because Timken bearings practically eliminate friction. They're geometrically designed to have true rolling motion and manufactured with microscopic accuracy to conform to their design. Closures are more effective because Timken bearings hold wheels, hubs and axles concentric. Dirt can't get in, lubricant can't get out. And Timken bearings shrug off the shock encountered pulling the trailer over rugged terrain because their rollers and races are case-carburized to give them a hard, wear-resistant surface over a tough, shock-resistant core. The fine alloy steel used in Timken bearings is made in our own mill. We're America's only bearing manufacturer that takes this extra step to insure bearing quality.

No other bearing gives you all the advantages that Timken bearings give you. Specify them for the machines you design, buy or build. Always look for the No. 1 sign of value on every bearing—the trademark "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

WE MAKE OUR OWN STEEL

The special grade alloy steel which gives Timken bearings their strength and resistance to wear is made in our own steel mills.

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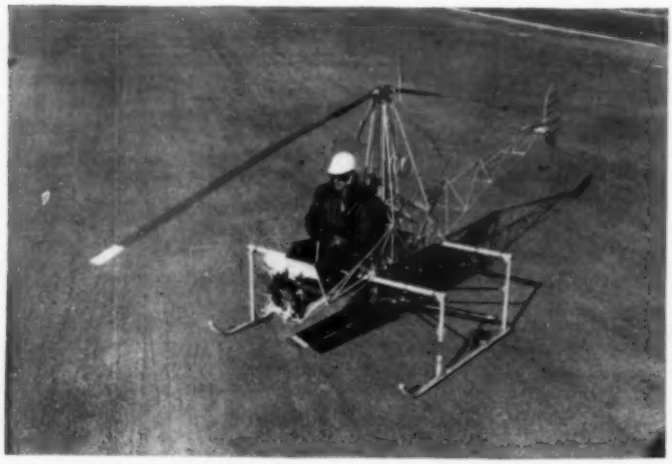


NAGLER HELICOPTER uses co-axial rotor and rotary engine to isolate torque loads from fuselage, reducing weight, maintenance cost.

Rotor Torque Eliminated in New Copter

White Plains, N. Y.—The elimination of rotor torque in a simple airframe was the guiding design criterion in the development of Bruno Nagler's latest rotary-wing craft.

The result is a co-axial helicopter of unusual layout: a small-chord, wide-span rotor above and a wide-chord, small-span rotor below the fuselage. Between these two lifting discs is a rotary engine, a sight not seen in aviation circles for more than a quarter of a century.

Nagler's ideas have tangible shape in a single-place test vehicle now flying at his company's area here at the Westchester County Airport. Next step in the company's plan is the construction of a pre-production prototype with an enclosed, two-place cabin.

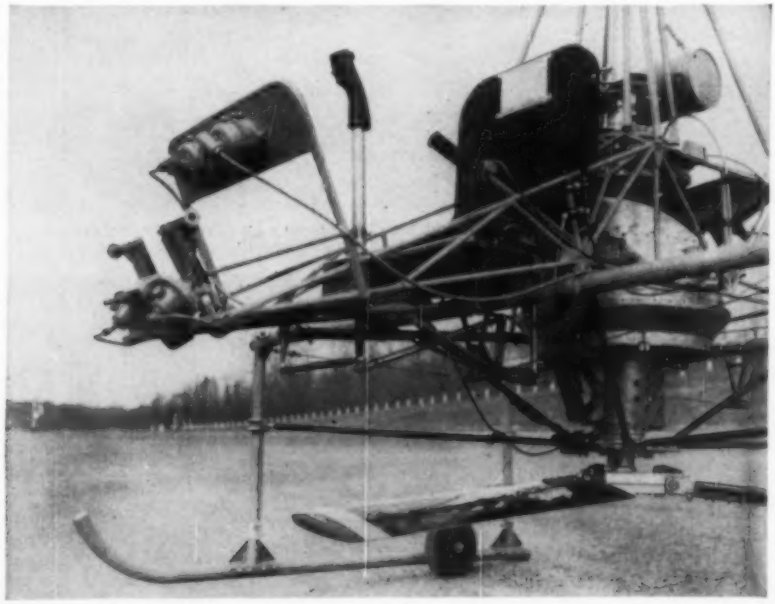
Integral Rotor System

The Nagler rotor system is an integral unit consisting of the two lifting rotors and their prime mover. In the test vehicle, it is slung between two bearings at opposite ends of the rotary-engine crankshaft. A third bearing acts as a steady-rest for the rotor head at the top of a tripod mast structure.

This unconventional plan makes conventional sense, because it isolates the torque-producing elements of a helicopter from the airframe. That step removes many of the usual helicopter troubles, which generally can be traced to taking out rotor torque reaction, engine vibration and transmission loads through the fuselage.

In addition to these certain mechanical advantages, there are aerodynamic benefits gained from the division of lift between upper and lower rotor. They include:

- **Partially unloaded top rotor** should permit higher forward speeds than with a conventional configuration. The retreating blade—less heavily loaded in Nagler's craft—does not stall as soon.
- **Lift distribution improvement** results from the layout. The hole in the doughnut-shaped distribution of a conventional rotor system is plugged by the lift from the lower rotor of the Nagler helicopter.
- **Ground cushion is "tremendous,"** because the belly-hung rotor is only a few inches off the ground. If a throttle stop were used, it would be impossible for a student pilot to get out of the ground cushion.



SHORT, BROAD ROTOR mounted below airframe turns counter to overhead rotor.

Design Details

The present test vehicle is powered by a McCulloch horizontally opposed target drone engine converted to a rotary configuration by Nagler Helicopter Co. It puts out 72 horsepower at 4,000 engine rpm., and is geared down 1.8 to 1.0 for the lower rotor drive.

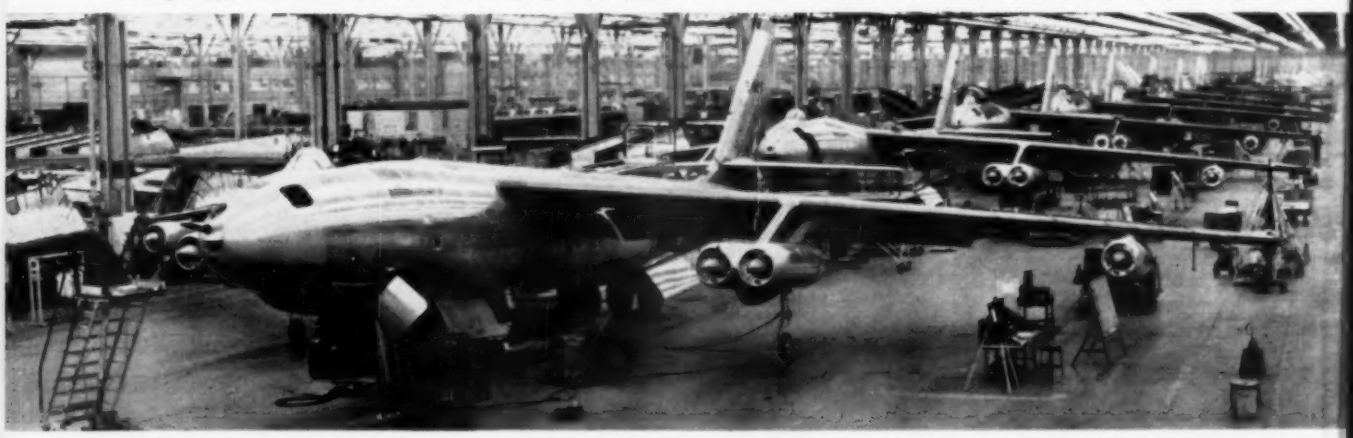
The gear train uses a chain drive from a motorcycle transmission; many other bits of the rotor system are stock automotive parts, mostly Chevrolet "be-

IT TAKES A BIG NEST TO HATCH A 62-TON BIRD!

Nestled in the foothills of the Appalachian Mountains, at Marietta, Ga., is a modern industrial wonder—the largest integrated aircraft plant under one roof in the world. It is Government Aircraft Plant No. 6, operated by Lockheed for the U.S. Air Force.

Ordinarily even a very large plant would have its hands full producing a plane as advanced as Lockheed's new 62-ton C-130 Hercules combat transport. Yet so large and efficient is GAP-6 that the Hercules assignment is but one of *three* major tasks handled *simultaneously!*

Side by side, new Lockheed C-130 Hercules planes (right) and Boeing-designed B-47 Stratojet bombers move along assembly lines at GAP-6. B-47s shown are earlier models being modernized by the extensive Mod-IRAN program (Modification—plus Inspect and



Parallel lines of B-47s stream toward military service at GAP-6. At left: new Lockheed-produced planes. Right: Mod-IRAN line (seen in reverse in top picture). Lockheed's 19,000 skilled workers keep both vital lines flowing smoothly. At the same time, they turn

QUICK FACTS ABOUT THIS GEORGIA INDUSTRIAL GIANT

The main factory building contains 3,265,000 square feet of production floor space. (Another 1,035,000 square feet in other buildings give GAP-6 almost 100 acres of production space under roof.)

3,361,500 square feet of paved area *outside* the plant provide another 76 acres of space for final work.

Final assembly bay has a 300-foot clear span, 45 feet high for its entire 2,045-foot length.

26 radio-controlled cranes, operating on 39 miles of overhead track, speed materials to any part of the plant in a matter of minutes.

50,000 *different* parts are fabricated in GAP-6, then rushed into production with clockwork precision.

Subcontracts and orders for parts and other materials have been issued to 7,800 individual contractors—77% of whom are in the "small business" classification.

LOOK TO

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GOVERNMENT AIRCRAFT PLANT NO. 6
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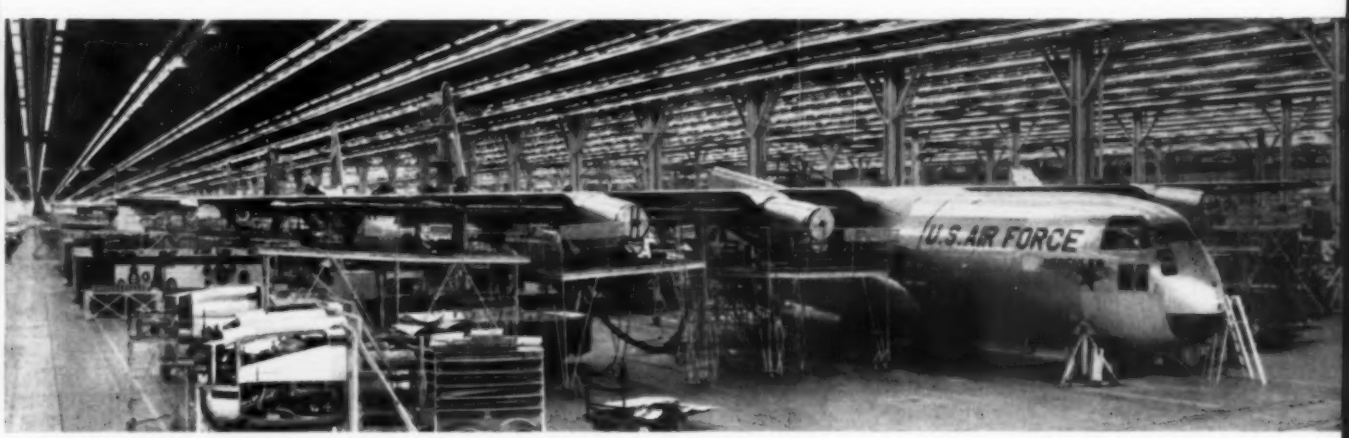
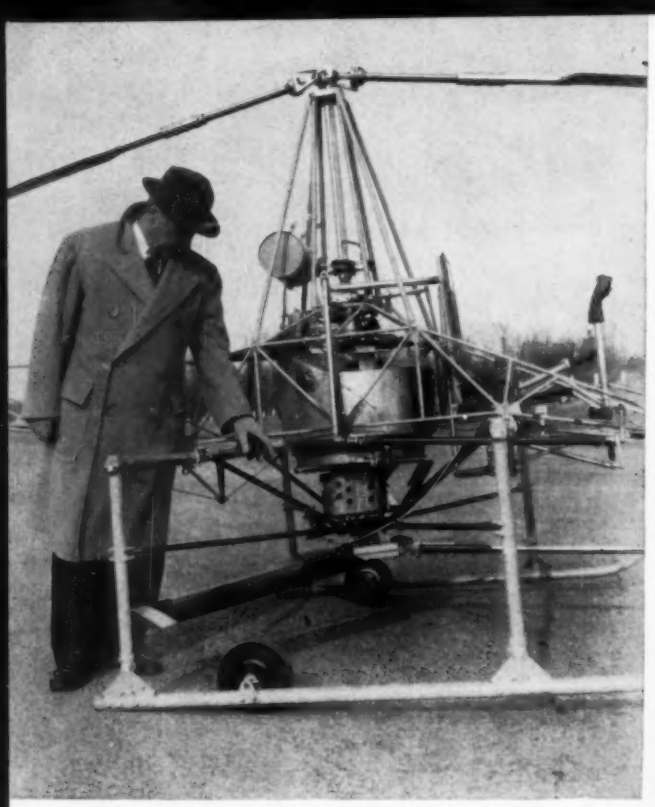
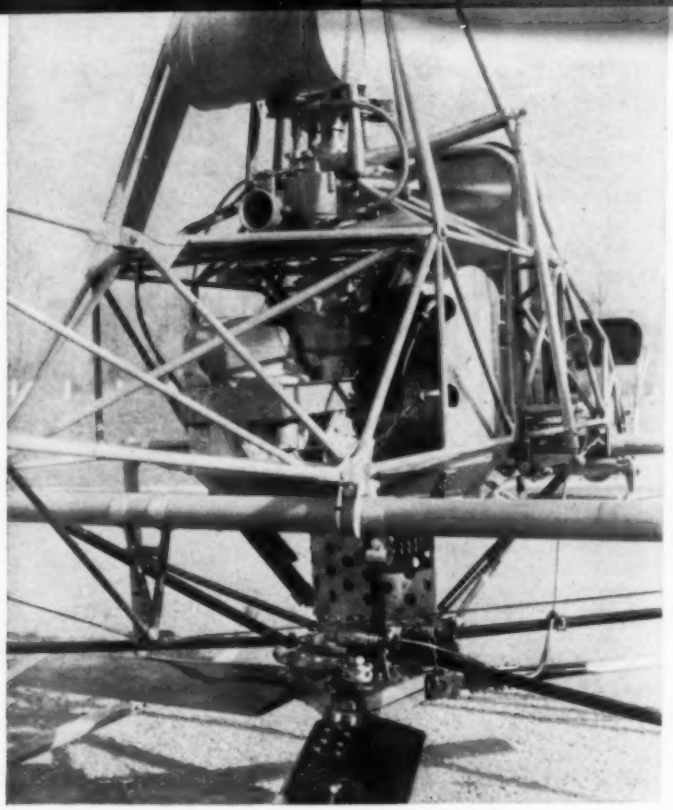


Repair as Necessary). This program includes over 200 modifications and requires major fabrication, assembly and flight-test facilities. It increases performance, range, combat capabilities and maintainability of older B-47s, making our defense money go further.

out the "New Strong Man of the USAF"—the Lockheed C-130 Hercules. This remarkable new propjet plane flies farther, faster and at less cost than any other combat transport. Below: C-130s await flight tests before assignment to Air Force Commands.





CLOSE-UPS show Nagler's contra-rotating rotors. Directional control comes from rudder-pedal-operated friction brakes.

cause that's the closest agency."

Top rotor has a 20-ft. span and a four-inch chord. The two blades are extruded aluminum alloy with an NACA 23012 profile. Rotor rpm. varies between 400 and 450 during normal flight.

The lower lifting unit is now an unshrouded, three-bladed rotor of seven-foot span diameter and seven-inch chord. Blades are built-up wooden construction.

The engine acts as a differential balance between the two rotors.

The absence of a tail rotor for anti-torque control means a different means must be used to change the directional heading of the helicopter in flight. The rudder pedals are hooked up to simple grab-type brakes, one above and one below the engine. By applying rudder, one or the other of these brakes absorbs some of the torque of either the lower or upper rotor and enables the ship to turn by the unbalance of torque.

Trainer Advantages

Nagler believes this current configuration offers many advantages as a training craft. The ground cushion effect makes it a simple matter for the novice pilot to gain confidence. In this respect, the Nagler craft resembles the "flying platforms" which operate essentially within the ground cushion and can be flown by inexperienced pilots.

But outweighing this flight advantage is the easy maintenance, Nagler says. Only about 15 hp. is transmitted to the upper rotor, so that none of its parts are highly loaded. This means that good design practices would almost guarantee an extremely long life for what would otherwise be one of the first components to give trouble. Engine and lower rotor maintenance would give no more trouble than their counterparts on light aircraft.

These same two major factors—easy maintenance and easy flying—could also make the Nagler machine an attractive commercial type. The company's plans for the pre-production prototype take this into account in cleaned-up lines and improved performance.

The next model will be powered by another McCulloch engine, also converted to a rotary and using fuel injection. The bottom rotor would be a direct-driven, four-bladed ducted fan of 5.5-ft. diameter. The main rotor system would be the same as the one on the test vehicle.

Payload of the commercial models would approximate 600 lb. Some cost estimates made with these tentative specifications as a guide have convinced Nagler that this might be the least expensive helicopter yet.

Human Factors Meet Scheduled for June

The fourth annual human engineering institute will be held by Dunlap and Associates, Inc. in Stamford, Conn., June 18-22.

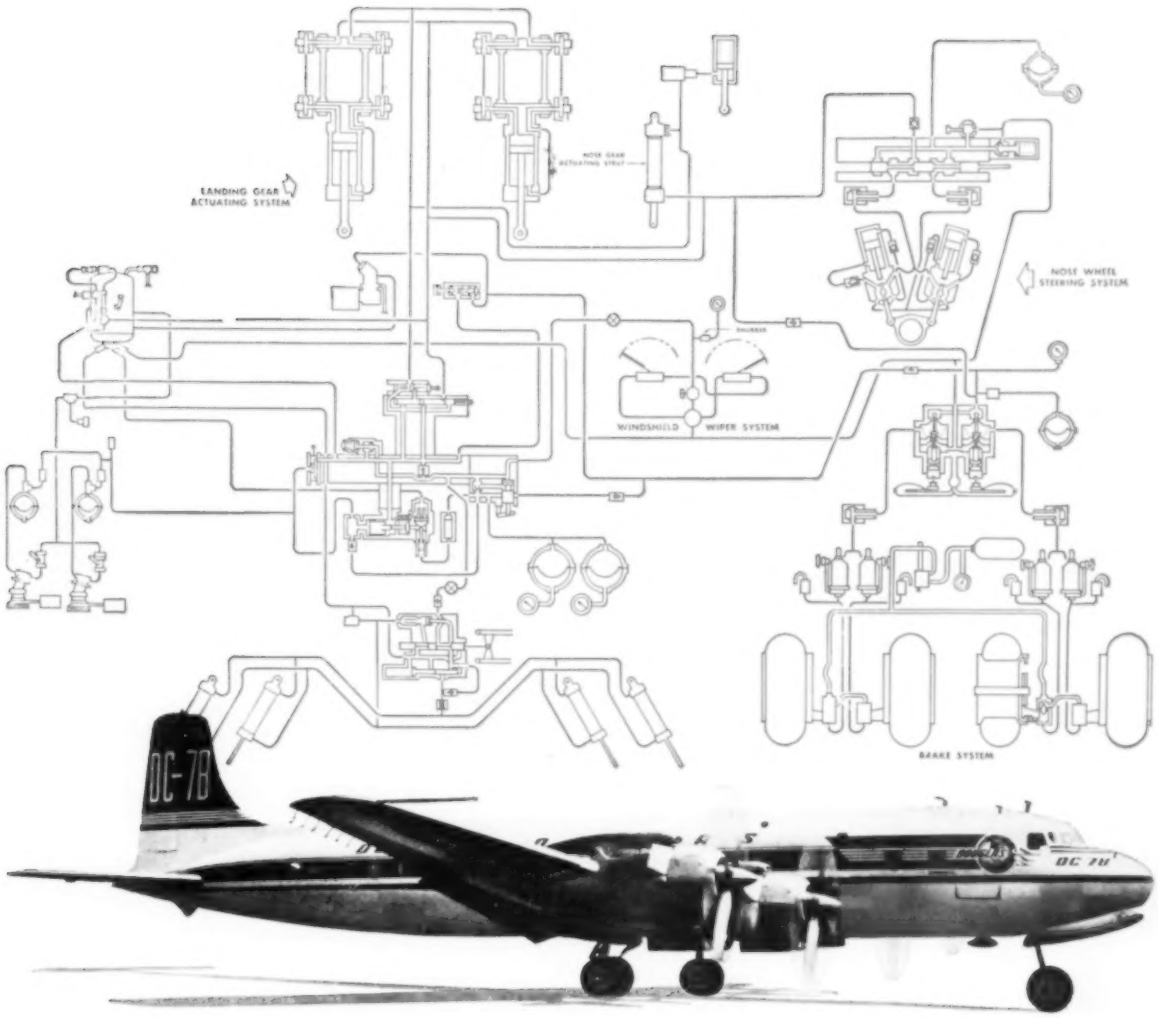
This year's program will be a five-day advanced course built around the newest concepts in design of equipment, consumer products and workplaces.

Emphasis will be on the systems approach to design planning. Other phases of the work will include: Allocation of functions between men and equipment, conversion of design specifications into hardware, and man-machine relations in automation.

Registration fee is $290, which includes textbooks and other materials. Enrollment deadline is May 21. Write: Dr. Leon L. Thomas, Director, Human Engineering Institute, Dunlap and Associates, Inc., 429 Atlantic St., Stamford, Conn.

United Changes Engine Order on Half of DC-8s

United Air Lines has split its order for 30 Douglas DC-8 jet transports to call for 15 with the Pratt & Whitney J57 engine and the other 15 with the more powerful P&W J75. Originally, United had ordered all 30 of its DC-8's with the J57 jet engine. W. A. Patterson, UAL president, said the first 15 planes equipped with the J57 would be converted to the J75 at a later date.



Enjay Butyl rubber— vital artery in newest airliners

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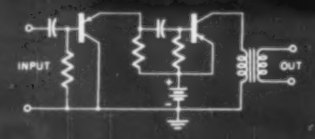

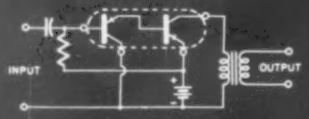

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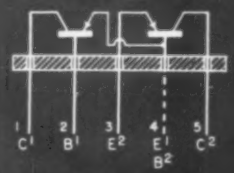
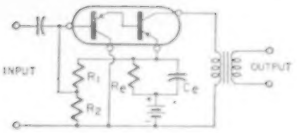


The outstanding development in the field of semi-conductor devices



Housed in a single case, two dc-coupled transistors now open an entirely new field for the mighty midgets of electronics as oscillators, multivibrators, flip-flops, switching devices, etc.!

A common-collector transistor stage acts as the input device of a second transistor to serve as a useful type of dc matching transformer. No extra power supply is required since the first transistor represents the base leak for its successor.

Now available in limited quantities for laboratories and research.

For complete details on the MT-1 Tandem Transistor write or wire:

MARVELCO *Electronics Division*
NATIONAL AIRCRAFT CORPORATION
3411 Tulare Avenue, Burbank, California

MARVELCO

In addition to the tandem transistor described on the preceding page MARVELCO also produces the following transistors available for immediate delivery in commercial quantities:

TYPE "J"
Audio Frequency Junction Transistor
The Type "J" is designed for use in medium gain, low-to-medium power applications at audio or ultrasonic frequencies.

TYPE "IF"
Intermediate Frequency Junction Transistor
Available for the first time is a transistor designed for switching speeds and still preserving high collector dissipation. For use in medium gain, low-to-medium power application at ultrasonic frequencies.

TYPE "HF"
High Frequency Junction Transistor
Type "HF" is designed for use in medium gain, low-to-medium power applications in the high frequency spectrum.

TYPE "JP-1"
Power Transistor
Designed for use in medium gain, intermediate power amplifier and switching applications. For maximum efficiency in push-pull operation, matched pairs may be ordered at no additional cost.

TYPE "RF-1"
Junction Type High Frequency "Ham" Transistor
Designed for use in medium gain, low-to-medium power applications in the high frequency spectrum.

TYPE "CQ-1"
Junction Type "Ham" Transistor
Designed for use in medium gain, low-to-medium power amateur applications at audio and ultrasonic frequencies.

MARVELCO TRANSISTOR SOCKETS
Socket permits ready interchange of transistors and precludes damage to transistor by soldering unit into a circuit. Designed for group mounting permitting space conservation when a large number of transistors are to be mounted in final assemblies such as computer circuitry. Also has high degree of utility in R&D bench work stage of circuit design.

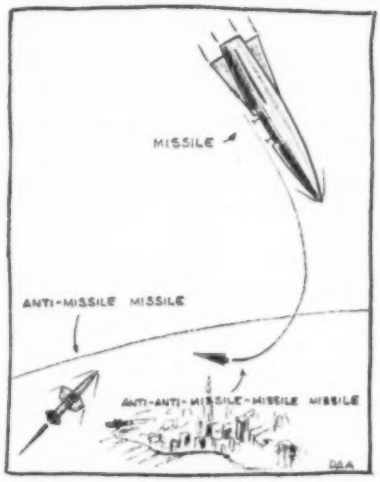
TYPE HS
High speed switching transistors having very rapid rise and power time characteristics. These units combine high peak current capability and low saturation potential drop. For use in computer and flip-flop application.

For complete specification data write to

MARVELCO Electronics Division
NATIONAL AIRCRAFT CORPORATION
3411 Tulare Avenue • Burbank, Calif.

NAC

THRUST & DRAG



Missile names are getting a bit silly, don't you think? I mean, your friends ask what you're working on, and you're going to tell them, "Ting-aling"? Or even, "Ding-Dong"?

But be of good cheer; AVIATION WEEK has learned that a plan to call the new ICBM and IRBM projects "Peter Pan" and "Wendy" respectively has been quietly dropped.

* * *

If you happen to own a small boy (or vice versa, which is the way it generally is), you can take his thoughts away from Davy Crockett and coonskins with this scaled-down, white USAF helmet.

It's a flexible plastic unit with a foam-rubber cushion at the top and adjustable

head and chin straps for fitting five- to fifteen-year-olds. There's a movable visor, an oxygen mask or voice mike—whichever you need at the moment—and a magnetic compass with siren attached.

Incidentally, if you don't explain the part about the siren, there's just a chance your boy won't find it out; this makes for domestic tranquility.

Bassons Industries Corp., makers of real "hard-hats" for grown-up Air Force, Navy and Marine pilots, also makes these boy-size units. They cost about $3, which is a small price to pay for the shining eyes and the look skyward when an F-86 bowls over the chimneys.

* * *

The engineering-wanted ads that feature lovely scenery
Would solve the problem neatly if instead they offered greenery.

* * *

I am promised a tax cut in 1957. I also will be disease-free, younger and safer in a peaceful world. The automobile accident rate will be down. The sun will always shine over Ridgewood, N. J., on a house which will require much less of my time and money.

Why?

'Cause by then we'll have the ESV—Earth Satellite Vehicle—that's why.

"Science's greatest triumph," trumpets a popular magazine, "heralds new life for all." This kind of blatant, grossly inaccurate overselling must bring tears to the eyes of the dedicated scientists who even now are sweating out the 5,000 hours till firing of what they fondly hope—and even pray—will be the first successful satellite.

And that one won't cut taxes, or eliminate muscular dystrophy, or keep it from raining on the weekend you want to lime the lawn. It will only be a useful little scientific instrument, to make it possible to learn something more about this minor planet of an undistinguished star.

* * *

Said B. C. Monesmith, Lockheed vp: "This plane (the F-104) could be cruising along minding its own business and be fired at by a 16-in. naval gun. If the pilot should happen to see it—which he could—he could avoid it, swing alongside and inspect it, and then accelerate away from it going in the same direction."

Cautionary note to curious pilots: If you try this, remember that the proximity fuse was invented in 1944.

* * *

Shall we bury Buck Rogers? I'm so tired of reading stories that begin: "The Buck Rogers era officially came to life today in the Arizona desert . . ." All you have to do is mention pressure suits or a rocket-powered airplane and there's ol' Buck, with his ROB (Rocket-on-Back) package, about to twist the knob of the gyro-cosmic-relativator.

Actually, the fictional hero of the elderly comic strip has long since been beaten to the technological punch every day by engineers and scientists in routine development work. Buck never even realized he could do anything to remedy those blisters on his bottom from the rocket exhaust.—DAA

Better Utilization Eases Engineer Dearth

By Henry Lefer

American industry has an estimated 50,000 new engineering jobs to fill this year. But less than half that number of engineers will graduate from the nation's schools and universities.

The year's crop of new engineers is reckoned at 23,000. About a third of these are members of the Reserve Officers Training Corps and will not be available until their military commitment has been taken care of, after which they may elect to continue in the service and remove themselves completely from the industrial market.

In the face of this situation, the aviation industry, along with other U. S. users of technical manpower, has been making great efforts to improve utilization of highly trained personnel and to attract a greater number of talented young people into the engineering profession.

But while these programs are being pursued, there is a mad scramble by industry for a share of the available supply, using almost every technique of advertising recruiting. However, the glowing advertisements picturing each aviation company as the answer to an engineer's prayer have a way of backfiring. Many engineers complain that they feel like a bride who has been swept off her feet by an ardent suitor, vowing undying love and promising her the world. Once the contract is signed, they say, the world has a way of shrinking and the ardor cools—especially since it must be shared with perhaps 2,000 others in the engineering harem.

The Engineer as a Person

James H. Taylor, director of industrial relations at Procter & Gamble, has some interesting things to say about this, and his remarks are not restricted to the manufacture of soap. For example:

- **We tell** the engineer we want him to have high technical competence, then assign him to non-technical jobs or jobs that can be handled by non-technical people.
- **We say** we want him to be creative, then have serious talks with him when he departs from conventional or time-tested ways.
- **We require** from him loyalty to management thinking, yet we isolate him from areas in which management concepts are involved.
- **We emphasize** the importance of his contributions as a technological specialist, but pass out our praises and dollars to the engineer who becomes a supervisor or production supervisor.
- **We demand** performance from him as an individual, but treat him physically as a member of an unidentified mass.

To point up the damaging effects of such management thinking, Taylor quotes a disturbing survey made as part of a masters' thesis by Henry E. Sodke, at Purdue University. This survey attempted to compare the attitudes of engineering students in college with those of engineers employed in industry. Among the findings:

- **Management recognizes** the engineer as a professional, with correlative authority and responsibility: 31% of the students thought yes; 24% of the engineers in industry thought yes.
- **The engineer** feels a sense of importance to the company: students, 36% yes; industry engineers, 22% yes.
- **Personnel policies** of the company do not maximize the engineer's contributions: students, 23% yes, they do not; industry engineers, 37% yes.
- **Employe will not** have an opportunity to contribute ideas on management decisions in his area of responsibility: students, 6% yes, they will not; industry engineers, 20% yes.
- **Employe will have** the opportunity to use a great portion of his training as an engineer: students, 43% yes; industry engineers, 27% yes.
- **The engineer seldom** knows if management is satisfied with his work: students, 10% yes; industry engineers, 28% yes.

This survey is disturbing from two viewpoints: Not only does it show the deterioration in attitude that takes place after the student enters industry and begins to rub against management practices; but it also shows the very large negative attitude existing in the students before they have had any direct contact with industry.

Shaping the Environment

Many companies are doing something about the conditions responsible for such attitudes. The following examples are typical.

At Glenn L. Martin, company policy is based on recognition of the needs of each human as an individual and establishment of an environment to satisfy these needs, according to George S. Trimble, Jr., vice president-engineering. Trimble says: "Management must feel that each individual can do better tomorrow than today, and provide the opportunity for him to do so."

General Electric seconds this attitude. "If we expect first-class engineering contributions, we must provide first-class surroundings," says C. H. Linder, GE's vice president-engineering. Furthermore, Linder says, engineers are vitally interested in knowing where they stand financially with respect to others in their field, and where they may expect to go. Management should provide this information. "One ounce of solid fact about salary will cure pounds of vague dissatisfaction," Linder says.

The need for communications, vertically from the top down, horizontally around the engineer, and circumferentially with the community, is stressed by Dr. Lyle Wheeler, vice president-engineering at Sperry Gyroscope Co. Sperry also stresses an open-door policy for every engineer who thinks he can do more or better in a different job. The policy is not designed to encourage job-hopping; on the contrary; the company feels it has produced greater stability by getting the right men into the right jobs.

At GE this policy of fitting the man to the job starts at the very beginning. When junior engineers are hired, after an orientation period including plant tours, formal talks and interviews, the new employe is given a temporary assignment, guided to the extent practicable by his own desires. After three months, he is re-interviewed, and if both he and his immediate supervisor indicate satisfaction with the arrange-

Continuing Shortage

The gap between demand and supply of engineers and scientists in this country is likely to grow larger as technology takes an even larger part in American life.

In this second of a two-part series, Aviation Week discusses how the present supply of trained manpower may be used more effectively and shows what can be done to increase the supply in the future.

Soviet Curriculum

Subjects	Hours	Distribution in percent	Term of study
Political	377	7.6	
1. Principles of Marxism-Leninism	248		1–2
2. Political economy	129		3–4
General scientific	1,456	28.8	
3. Foreign language	266		1–4
4. Higher mathematics	340		1–2
5. Physics	200		1–2
6. Chemistry	138		1
7. Descriptive geometry	92		1
8. Drawing and graphics	216		1–2
9. Theoretical mechanics	204		1–2
General engineering	1,407	27.8	
10. Physical metallurgy	107		2–3
11. Strength of materials	170		1–2
12. Theory of machines and mechanisms	124		2–3
13. Machine components	201		2–3
14. Metallography	105		3
15. Nomography	30		3
16. Electrical engineering	112		3
17. Fluid mechanics	54		4
18. Tolerances and measurements	72		3
19. Thermodynamics and heat-power engineering	91		4
20. Study-practice	341		1–3
Specialized engineering	1,286	25.4	
21. Lifting machines	76		3–4
22. Machine tools (general)	80		3
23. Kinematics of machine tools	36		4
24. Design and calculation of machine tools	116		4
25. Technology of metal cutting	80		3
26. Cutting tools	100		4
27. Technology of machine building	230		4–5
28. Welding	64		4
29. Machine foundings	48		4
30. Drives	16		4
31. Cold stamping	60		5
32. Structures and their design	40		5
33. Machine-shop layout	60		5
34. Electric equipment	50		5
35. Automatic machine tools	40		5
36. Heat treatment (tempering)	30		5
37. Organization of production	78		4–5
38. Cost accounting and norms	32		4
39. Fire prevention and safety	50		5
Other	528	10.4	
40. Physical training	124		1–2
41. Military training	404		1–3
Total	5,054	100.0	
of which—lectures	2,390	47.2	
laboratory, practice	2,664	52.8	

M.I.T. Curriculum

	Subjects	Hours	Distribution in percent	Term of study
I.	**Humanities and social sciences (not differentiated)**	360	12.4	1–8
II.	**General scientific**	1,125	38.9	
	General inorganic chemistry	210		1–2
	Physics	330		1–4
	Calculus and differential equations	180		1–4
	Descriptive geometry	90		2
	Engineering and machine drawing	180		1, 3
	Theoretical mechanics:			
	Statics	45		3
	Dynamics	90		4, 6
III.	**General engineering**	630	21.8	
	Technical mechanics:			
	Strength of materials	90		5, 7
	Testing materials laboratory	60		6
	Machine design	135		5, 6
	Fluid mechanics	75		5, 6
	Fundamentals of heat power engineering	120		5, 6
	Fundamentals of electrical engineering	60		6
	Engineering metals	90		4
IV.	**Specialized engineering**	510	17.6	
	Machine tool laboratory and practice	120		3, 4
	Engineering laboratory	120		7, 8
	Metal processing	60		7
	Mechanical behavior of metals	30		7
	Metal cutting principles	45		7
	Mechanical engineering problems	45		8
	2 elective half courses	90		7, 8
V.	**Other**	270	9.3	
	Athletics	60		1, 2
	Military science	180		1–4
	Quiz periods	30		1, 2
	Total	2,895	100.0	

TABLES COMPARE mechanical engineering curriculum of Soviet university with that of Massachusetts Institute of Technology.

ment, this job becomes his permanent assignment. If not, he makes a three-month trial at another job. Usually it takes no more than three such trials to find a permanent slot for a new man, GE says.

The engineer must be given the opportunity for professional growth. There are several ways of doing this. He is encouraged and aided in joining professional societies. He is given help in the publication of professional papers. Advanced study is encouraged and its cost often reimbursed. At Sperry, more than 600 employes are now attending school under a program where the company will refund up to half the tuition cost. Sperry also permits its engineers and scientists to use their work at the company as the basis for their thesis. The company also allows time off for engineers working toward their doctorate.

Republic has set up a $10,000 fund, administered by assistant chief engineer Bortner, to send company engineers to short courses and seminars related to their work.

Many engineers resent the fact that often they can advance only by moving into managerial or supervisory positions. Not only does this represent a morale problem, but it is a drain on the available creative engineering supply. Many companies in aviation provide parallel ladders for advancement.

Trimble says Martin feels that engineers and creative people should be able to climb the ladder of salary and prestige without having to switch over to the management side of operations. Managers and supervisors are necessary, and those showing the required talent are encouraged and helped into this field.

General Electric also is trying to provide parallel paths. But it is important to remember, says Linder, that engineers do make good managers. Of GE's 100 decentralized operations, about 75 are managed by engineers, Linder says.

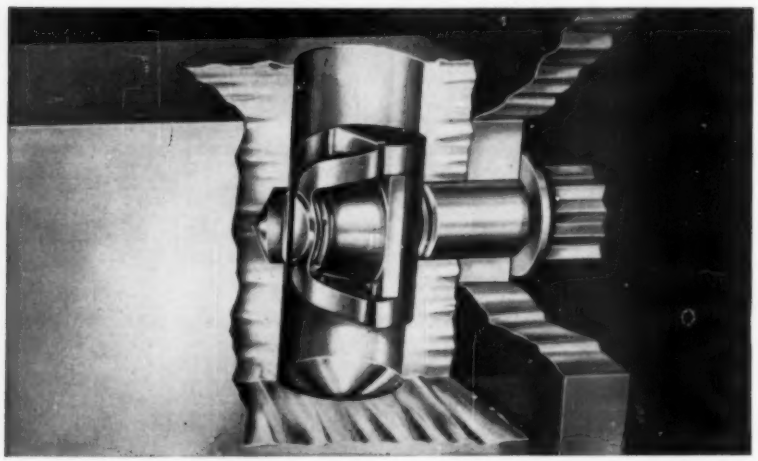
Do aviation companies over-advertise, over-hire and hoard engineers? A number of firms frankly admit they do. Probably the great majority are guilty. But there are reasons.

Dr. S. W. Herwald, manager of engineering at Westinghouse's Air Arm division, points out that the average company may be trying to land a number of contracts at any time. In today's tight market, it would be suicide to have to start assembling the necessary engineering staff after the contract is signed. So Air Arm, for instance, hires engineers on what Herwald calls an "opportunistic basis"—whenever and wherever they are available.

For the same reason, a company does not let its valuable engineers go when contracts are canceled or completed, Frank Fink, vice president and chief engineer at Ryan Aeronautical Co., points out. Instead the company may draw up new projects to keep its personnel busy until a new job comes along.

Many engineers complain that in this

FASTENER PROBLEM



Reducing weight and saving time in joining major substructures

Use of a hex shaped or 12 point type nut to join major aircraft substructures and components means two costly, time-consuming operations: 1) end-milling bathtub recesses to provide adequate wrenching area, and 2) precision drilling mating bolt holes . . . and an accompanying high percentage of misalignment rejections. A simplification of these fastening operations has long been an objective of every major American aircraft manufacturer.

ESNA type 2552 is the newest and most efficient solution to this problem. **First,** the shape of the nut fits into a simple drilled hole . . . the nut does not have to be held for wrenching. The bathtub recess for the nut is completely eliminated. In many cases this permits major reductions in the size and weight of the forging or structural members to be joined because edge distances can be reduced.

Second, a floating action of .030", perpendicular to the axis of the bolt hole, is designed into the nut. As a result misalignment rejections are virtually eliminated and production economies result from working to the normal tolerances required for installation.

Barrel design eliminates need for wrenching area. "Floating" principle eases close tolerance requirements and compensates for misalignments. Shown without clip.

Third, a steel clip is offered which snaps on the nut and when the unit is inserted into a drilled hole it locates and holds the nut in the proper position to receive the bolt.

Fourth, to meet the tensile requirements of these critical applications this nut develops 180M psi at the pitch diameter of the bolt.

Fifth, type 2552 is made lighter in weight by using an aluminum alloy cradle to support the nut body.

Sixth, this new high tensile floating barrel nut uses a red nylon locking collar to guarantee vibration proof, self-locking performance and extended re-usability.

Do you have an assembly problem the new type 2552 can solve? It is available in ¼-28 through ¾-16 fine thread sizes.

MAIL COUPON FOR DESIGN INFORMATION

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Elastic Stop Nut Corporation of America
Dept. H69-325, 2330 Vauxhall Road, Union, New Jersey

Please send me the following fastener information:

☐ Elastic Stop Nut bulletin
☐ Reference book of fastener problems
☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone_____ State_____

situation they are often reduced to "boondoggling" or doing "WPA-type" work. They complain too that the industry has for several years been operating under a "gentlemen's agreement," which makes it difficult for an engineer to better himself by moving from one company to another.

'Gentlemen's Agreement'

The Engineers and Scientists of America say this "gentlemen's agreement" dates to a 1951 letter from Brig. Gen. Arthur Thomas, then commanding officer, Headquarters, Eastern Air Procurement District, asking the aircraft industry not to "engage in disruptive practices" such as pirating workers from other essential industries, advertising indiscriminately, hiring workers from outside the community before full use is made of local, qualified manpower or hiring more than needed or can be absorbed in a reasonable time.

ESA says the only request of Thomas' letter that the industry has followed closely is that about pirating. Most companies in the past have refused to hire an already employed engineer unless he had first obtained a written release from his present employer (who was then supposed to forward his personnel file to the new employer) or had been out of work for at least 30 days. To ESA this practice is "unfair and discriminatory" and "persistently and flagrantly adverse to the interests of professional engineers and scientists."

This policy may be due for a change. In reply to a letter from ESA president Joseph Amann, Assistant Secretary of the Air Force Dudley C. Sharp wrote on Dec. 22, 1955, that Gen. Thomas' letter had been written in the context of the Korean war when Air Force was worried about industry's ability to meet production schedules. "The Air Force does not have an existing policy in effect respecting compulsory manpower controls," Sharp concluded.

Salaries Will Rise

If the lid is lifted, observers do not believe it will necessarily be reflected by easing the engineering situation. The primary result will be that engineering salaries will rise to the extent warranted by the tight supply. However, it may reduce the large "floating population"—engineers in the process of changing jobs. It has been estimated that a loss of as much as 5% of our engineering productivity can be traced to the men who are between positions or in the process of becoming familiar with their new position.

Until now, ESA says, it has been mainly the new engineers who have benefited from the shortage—the 5,000 organizations with 50,000 openings bidding for this year's 23,000 graduating engineers are driving beginning wages

up to around $400 a month. ESA warns the young engineers they may soon find that they are getting a good share of their first three years' merit raises in their high starting rate. "The only cure for this compression from the bottom is elevation of the whole engineering salary struture," ESA claims.

Frank Fink says that duplication of effort wastes a great deal of technical manpower.

One source of this wasted effort is the practice in many organizations of going full speed ahead when a new project is started. The development, design, even production groups, immediately go into full operation, hoping thereby to save time in the long run. But in the long run, as correct technical data becomes available, much of the work must be revised or done over.

Often manpower is wasted by the duplication of effort between the prime contractor and his suppliers—duplicate testing of equipment and components, for example.

Air Force is trying to end another major source of duplication by hand-picking contractors for major projects, instead of calling for design studies and proposals from the entire industry.

Projects vs. Systems

A number of companies have reorganized their engineering set-ups to make more effective use of trained manpower.

Republic, for example believes that it has gained important advantages by changing from a project type organization to a systems engineering organization. Under the systems set-up, the project engineer retains over-all charge of a project and is responsible for the aircraft structural shell. Bortner compares him to a "general contractor," who then "lets out subcontracts" to the various systems groups—each with its own chief—for hydraulic, armament, powerplant, controls, mechanical and electrical work.

Since the same chief is in charge of the same phase for all of the company's projects, improvements developed in a particular project are quickly fed back into all projects. This set-up also gives better control of manpower, Bortner says. Previously, after the workload had its peak, a project engineer often tried to hoard engineers for his next project. Under the new set-up, as soon as a systems engineer finishes his job he returns to his systems chief, who can then assign him to a new project.

Not all companies see the systems' approach as the answer to their problems. Some, such as Northrop, have instituted a hybrid organization, combining features of both types. Some, like Sperry, believe the efficiency of a particular type of set-up depends on the ability of the managerial personnel. Furthermore, Sperry believes the proj-

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TYPE 30E16 DC GENERATOR

With its 30-volt, 100-ampere rating, the Type 30E16 offers increased output and reliability that make it the ideal replacement for existing 50 and 75 ampere aircraft generators. In most cases, it can be used with existing control equipment—with types 1042-17 and 1589-1 voltage regulators, for example.

This generator can be furnished with either square or round mounting flange and is suitable for use on P & W 985, P & W 1340 and P & W 1830 engines.

For military applications, the generator conforms to AF Drawing 52B-6588 and will deliver full output at 35,000 feet altitude and 75% rated power at 50,000 feet.

CHARACTERISTICS

Speed	2500-4500 rpm
Min. Speed for Regulation	2500 rpm
Max. Speed for Regulation	5500 rpm
Power	3000 watts
Min. Air Blast Pressure	6 in. water
Weight	39.5 lbs.

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NEW...A SILICONE RUBBER

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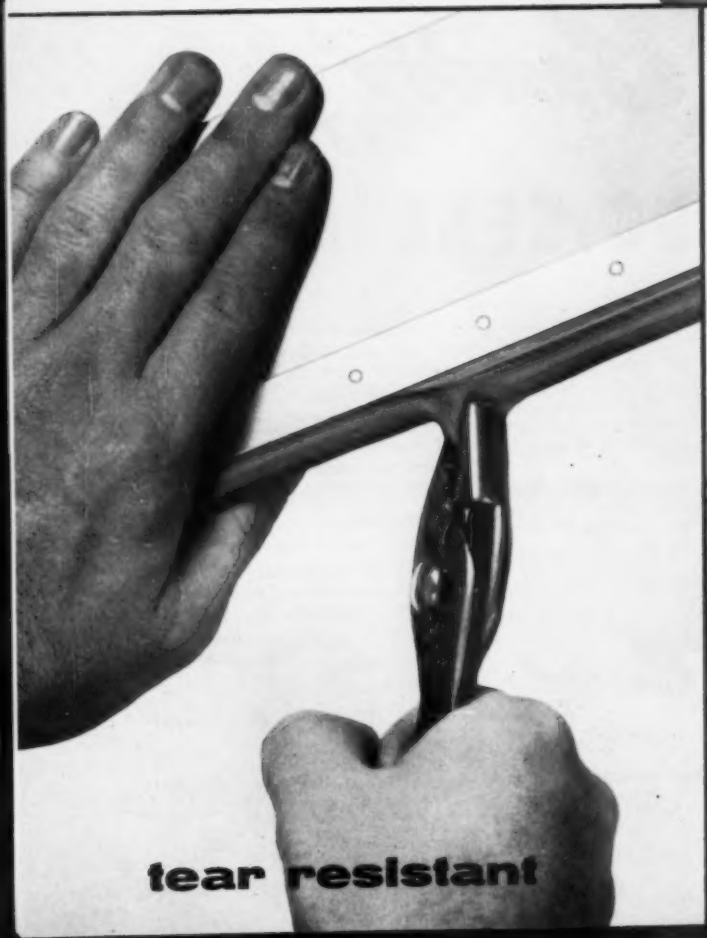

tear resistant

abrasion resistant

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NEW COHRLASTIC HT SILICONE RUBBER MAKES SEALS TWICE AS STRONG IN TEMPERATURES —100° F TO 400° F

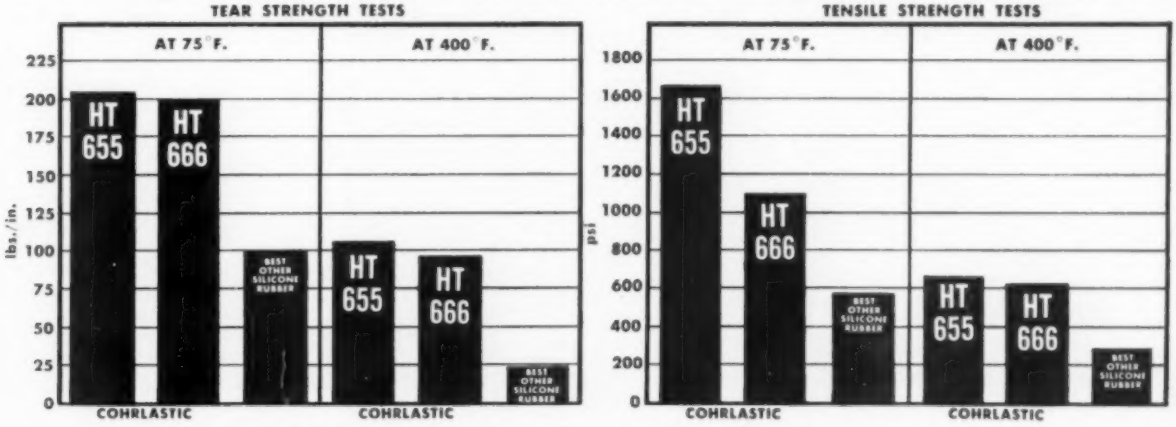
Possessing high physical properties, roughly twice those of any other commercially available silicone rubber, two new compounds, *Cohrlastic HT 655 and HT 666*, offer a useful combination of high strength, excellent abrasion resistance and extremely good tear and cut resistance at temperatures far beyond the range of other silicone rubbers.

Seals, fabricated from these remarkable compounds, greatly reduce maintenance costs and offer increased service life because of their excellent strength properties at 400°F and good flexibility at low temperatures (−100°F for HT 666, −65°F for HT 655).

Advance tests by process groups of several major aircraft companies have resulted in preliminary specifications of HT 655 and HT 666 for seal design for new jet aircraft. Highly recommended for use as seals for drop tanks, pylons, under wing stores, hatches, windows and drag chute doors.

For information and engineering assistance with your particular seal application, write to: The Connecticut Hard Rubber Company.

TESTS PROVE COHRLASTIC HT 655 AND HT 666 FAR SUPERIOR THAN OTHER SILICONE RUBBERS



typical properties

	COHRLASTIC HT 655 50-Durometer	Actual Value	COHRLASTIC HT 666 60-Durometer	Actual Value
As Received				
Durometer	54		62	
Tensile Strength, psi	1650		1100	
Elongation, %	820		650	
Tensile Stress at 100% Elongation	174		225	
Tear Resistance lbs./in.	206		200	
Dry Heat Resistance, 70 Hrs. @ 400°F.				
Hardness change	+14		+8	
Tensile Strength Change, %	−30	1080 psi	−9	1000 psi
Elongation Change, %	−34	540 0/0	−35	425 0/0
Tear Resistance Change, %	+14	235 lbs./in.	+32	264 lbs./in.
Bend (flat)	No Cracking No Checking		No Cracking No Checking	
Compression Set, Percent of Original Deflection				
70 Hrs. @ 212°F.	29		26	
22 Hrs. @ 300°F.	40			
70 Hrs. @ 300°F.	69		65	
Low Temperature Resistance Young's Modulus ASTM D-797-46				
at −65°F. Max., 10,000 psi	Pass		Pass	
at −100°F. Max., 10,000 psi			Pass	

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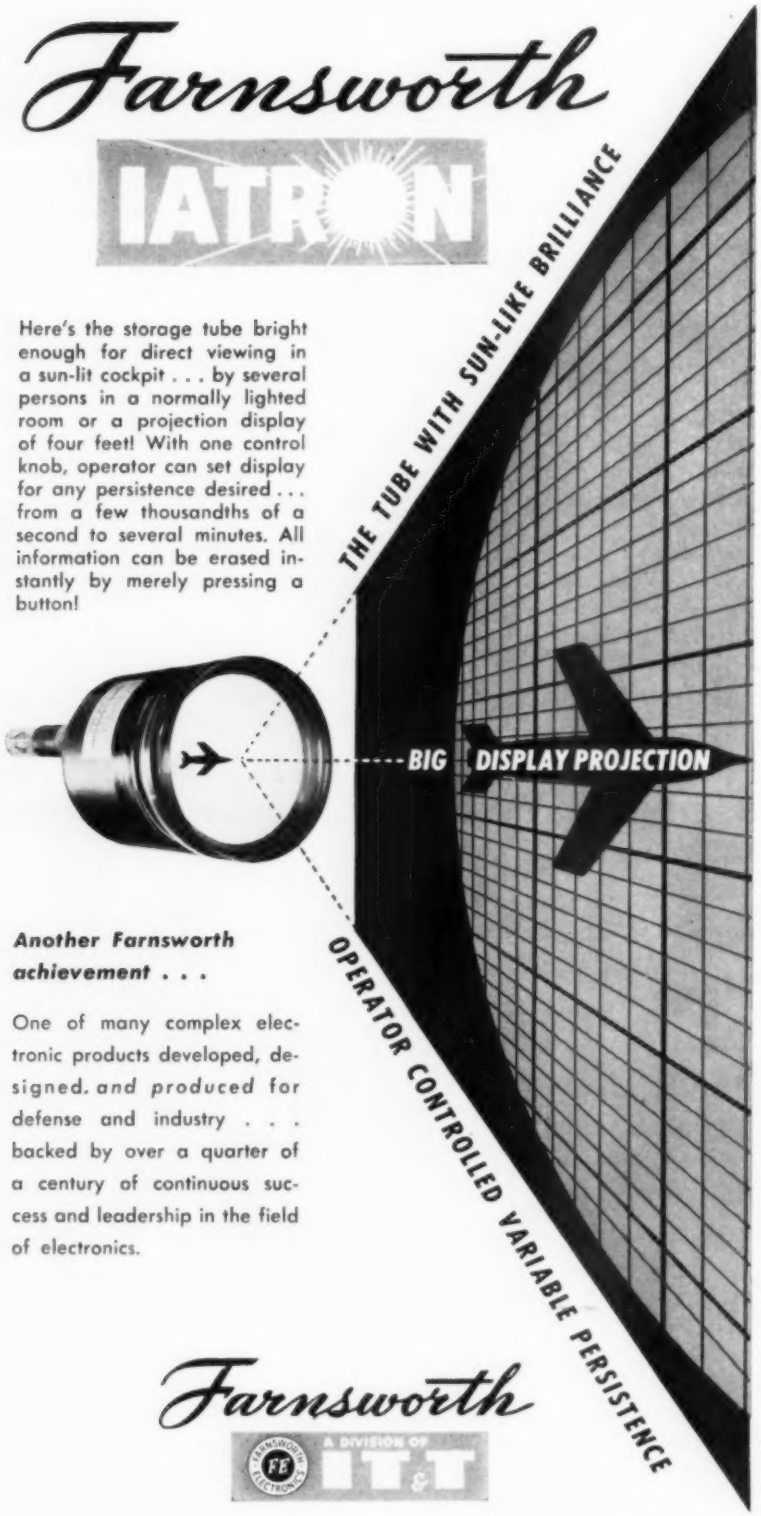

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ect approach develops greater esprit de corps among engineers, and is a good morale booster.

Republic, Northrop and General Electric, to mention only three companies, are actively recruiting Canadian and other alien engineers.

Hiring Aliens

The process of hiring aliens is long and complicated. As a result the companies are looking for higher-level personnel than they recruit in this country because of the time and expense involved.

In general, the alien must declare his intention of becoming an American citizen. In addition, it involves dealings with the State Dept., Federal Bureau of Investigation, Central Intelligence Agency and foreign governments. Republic, which is probably the pioneer in this field, says it takes an average of 10-14 months to get an "alien" engineer cleared for classified work.

Bortner says that Republic has already hired several engineers of this type, with several more now in the pipelines.

Farming work out to subcontractors does not relieve the overall engineering shortage, but it does offer the individual firm possibility of help.

Some aircraft companies subcontract as much as half their work. However, many like to limit their subcontracts to complete packages, such as power packs, etc., preventing wider use of this technique.

Industry is getting a better break in the military draft situation as a result of a recent Presidential change in Selective Service regulations.

Military Service

The new regulations make it possible for young men in certain fields to fulfill their military obligation by serving six months on active duty, after which they are transferred to the Standby Reserve, instead of the Ready Reserve as heretofore. In the Standby Reserve, they are not liable for call in Korea-type emergencies, but only upon declaration of war or an emergency declared by Congress.

The new regulations make several important exceptions, however. Ineligible for six-months' training and transfer to standby are those with skills critically needed by the military. These include aircraft and engine mechanic, electronic technician, instrument repairman and machinist.

In the long run, increasing our total supply of engineers depends on increasing our supply of properly trained and enthusiastic teachers. However, here too, there is a serious shortage.

Dr. Ray Maul, in his Report on the Eighth Annual Teacher Supply and Demand Study, points out that against

a need of 1,814 mathematics teachers last year, for example, there was a theoretical supply of only 1,160. The deficit was supplied by utilizing general science teachers (292), social science teachers (110), physical education teachers (87), physics teachers (63), and assorted teachers (197, including 11 music instructors!).

David Sarnoff, chairman of the board of Radio Corporation of America, suggests setting up an interim educational reserve consisting of industry engineers and scientists who would be released from their jobs for a year or more to teach mathematics and sciences in local high schools. The Glenn L. Martin Co. has started a similar program on the collegiate level, with assignment of the head of its missiles systems electronics, Dr. Fred B. Haynes, to Drexel Institute of Technology as a professor in electrical engineering.

A commonly used technique is to offer college and high school instructors part-time or summer employment in the aviation industry. This offers twofold benefits: It raises the instructor's income, making it easier for him to remain in the teaching profession; and it acquaints the instructor with industry's current needs and practices, theoretically making him a better teacher. Furthermore, if relations are mutually satisfactory, the instructor often becomes a good missionary among his students for the company that employed him.

Some instructors object, however. Rather than get extra pay for working during their summer vacations, they would prefer to see the general teacher salary structure raised.

An official of the New York City Board of Education has recommended, among other things, that science and math instructors be permitted to teach extra classes for extra pay, thus extending the supply. Another relatively untouched source of teaching personnel is the pool of retired engineers and teachers, who might be brought into the picture as part-time personnel.

Cooperative Education

Many companies have cooperative arrangements with schools, whereby students attend classes for three months or a semester, then work in industry for a corresponding period.

This helps finance the students' way through college and results in eventual production of a more fully rounded engineer.

United Aircraft Corp. in cooperation with Rensselaer Polytechnic Institute last year pioneered a new approach to the problem of providing graduate engineering training when they set up a graduate-branch of RPI near Hartford. The faculty consists of RPI instructors and qualified UAC engineers and scientists. Planned primarily as a means of

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permitting UAC personnel to pursue higher education while maintaining employment with the company, the school will be opened later to any resident of the Hartford area.

Along with increasing the supply of teachers this country must consider raising the level of what is taught, many observers feel.

DeWitt, in his study of Soviet professional manpower, points out that Russian training in mathematics and the sciences appears to be more thorough than ours.

Soviet engineering education is characterized by long hours, full weeks, and a substantial part of the year spent in actual attendance at class—far more than the equivalent in the United States, DeWitt says.

DeWitt points out that in Russian elementary schools, grades 1 to 4, technology and basic sciences take up 28% of the school time; in intermediate grades 33%; in upper secondary school grades, the figure is over 40%.

In engineering schools, approximately 6-8% of the time is spent on what we would call the "humanities"; more than 25% is spent in general science; 25% is spent in general, non-specialized engineering; the remainder, except for 6-10% devoted to military training and physical education, is spent in the student's narrow engineering specialty.

Brig. Gen. Carlton S. Dargusch, assistant director for manpower, Office of Defense Mobilization, suggests a national system of awards to increase student as well as teacher interest in science and technology.

Dargusch's proposal is for an initial fund of at least $1 million. The awards would go to students and teachers in both high school and college for superior performance and outstanding contributions.

Several programs along this line have been in force for some years. Probably the best known is Westinghouse's annual science talent search.

In addition, several companies, notably General Motors, maintains a long-term promotional program, designed to interest the nation's youth in technology as a career.

Education got a tremendous boost late last year when the Ford Foundation announced its $500-million grant, mainly designed to raise teaching salaries. In addition, more scholarships are being made available constantly to help those attend school who might otherwise not be able to.

Today, fewer than half the young people in the top quarter of the population from the IQ standpoint finish a four-year college course. The most general reason behind this failure is financial. It is hoped that increased scholarship opportunities will help increase the yield from this rich source.

Equipment Makers Switch to Metal Filters

By George L. Christian

New York—A major swing to metal filters is being forced upon equipment manufacturers by the increasing generated heat from airframes and engines. The problem is greatest in hydraulic systems, but it also is becoming a factor in fuel and pneumatic systems.

In hydraulic systems, heat is already reaching beyond the 275F limit of standard, paper-type filters used today. It will soon, in many installations, exceed the 400-450F limit of resin-impregnated, synthetic fiber filters.

Manufacturers have come up with several types of metal filter to answer the challenge of high-heat (and often corrosion) resistance, coupled with very fine filtration capabilities (down to 0.5 micron), low pressure drop, high intrinsic strength, and complete lack of media migration (the breaking away of parts of the filter with subsequent contamination of the hydraulic system).

Among the leading contributions made in the field of metal aircraft system filters are:

• **Poro-Klean** porous sintered stainless steel or other metal filters, which resist temperatures over 1,000F. A special process of precision selection of spherical metal particles for use in the sintered filters allows the manufacturer, Cuno Engineering Corp., to produce filtering material of highly uniform porosity.

Cuno claims a first in the field of magnetic filtration. By incorporating a strong magnetic field in a Poro-Klean-type filter, contamination as microscopic as colloidal iron can be efficiently removed from hydraulic systems.

Among test applications of various Cuno filters are hydraulic units for the Republic F-105, Convair B-58 and Boeing RB-47; filters for the air portion of the F-89's fuel control, and pneumatic filters for a new Grumman aircraft.

• **Rigimesh,** a sintered woven wire cloth unit which filters down to 5 microns with a very low pressure drop, has been developed by Aircraft Porous Media, Inc. The wire cloth may be made of various metals, including stainless steel, Monel and Inconel. The feasibility of using aluminum or titanium is being investigated.

APM says its Rigimesh filters have been specified for certain applications on the F-105, F-107 and B-58. The company also makes a large variety of sintered porous metal filters and large (18x72-in.) porous stainless steel sheet.

• **Sintered metal filter,** featuring an extended area principle, was recently announced by Purolator Products, Inc. By using pleated porous metal configurations, more filtering area is crammed into a smaller space. Designed to operate at 1,000F or higher, the unit can filter out particles down to 5 microns, according to Purolator. About 250 units are currently being service tested by major airframe manufacturers.

Use of the porous metal and wire cloth materials has spilled over into these non-filter-type applications, which may help solve serious control and heat problems in tomorrow's fast-flying jets and missiles:

• **Boundary layer control.** Edward Kane, Cuno's manager of aircraft sales, told AVIATION WEEK that his company has taken orders for specimen sections of sintered metal to be used for boundary layer control experiments by the Battelle Institute and by the manufacturer of one of the country's speediest interceptors.

Dr. David B. Pall, president of the Pall Filtration Co. (parent organization of Aircraft Porous Media), says that porous wing flap leading edge strips made with APM material have been used successfully for suction boundary layer control on an experimental F-86. He anticipates more such applications.

• **Transpiration cooling.** Cuno has an immediate application of its sintered porous stainless steel as a transpiration

West Coast Contender

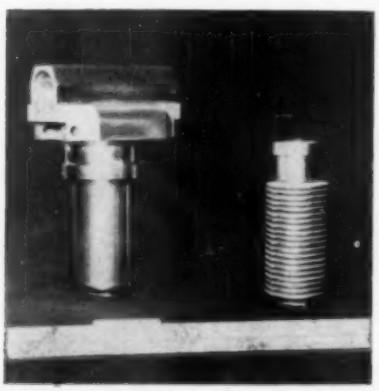
Poroloy, a new porous wire material made by flattening fine wire into a ribbon, then wrapping it on a mandrel and sintering it in a controlled atmosphere oven, is finding numerous aircraft and missile applications (AW July 11, p. 65). Production models of Poroloy filters are being used on the Douglas A4D and F4D, Convair's F-102, Lockheed's Super Constellation and Firestone's Corporal missile, according to Poroloy Equipment, Inc., the filter's manufacturer.

The material can be fabricated from numerous types of metal including stainless steel, Haynes alloys, Nichrome, nickel, copper and brass.

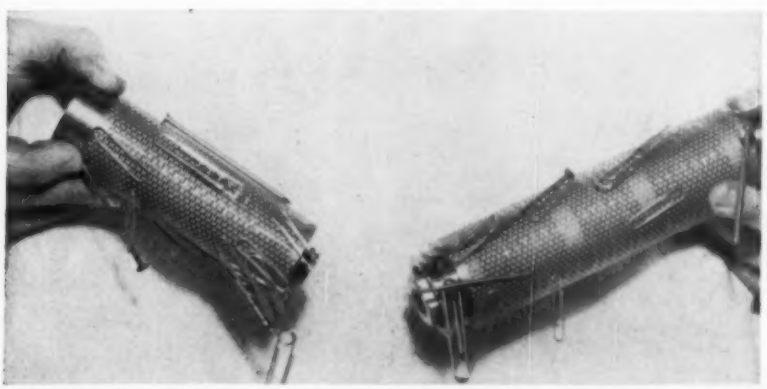
Poroloy can filter down to ten microns, resists high heat, and can be used in either air or hydraulic applications. Its relatively high strength allows it to resist system surges above normal pressure.

Poroloy can be made in sheets, in seamless tubing of various diameters, and it can be formed into relatively complex shapes.

The company says that it is also very active in the fields of transpiration cooling and boundry layer control.



NON-MAGNETIC 3-gpm. Poro-Klean filter. Fluid passes through stacks to center of unit.



MAGNETIC Cuno Poro-Klean's Alnico units hold paper clips and nails to coarse nickel shrouds, which also serve to form a return path for magnets' flux path.

APRIL 23rd

AIR TRANSPORT Facts and Figures

(PUBLISHED BY THE AIR TRANSPORT ASSOCIATION)

AVIATION WEEK has been officially designated to resume the publication of "Air Transport Facts and Figures," published by the Air Transport Association. This editorial feature will appear in our April 23rd issue and will provide an impressive picture of the tremendous progress achieved by the carriers during the past year. A.T.A. is to be congratulated on making this vitally important editorial feature again available to AVIATION WEEK, thus insuring a vastly expanded audience and a world-wide impact.

AVIATION WEEK average net paid ABC circulation June-December, 1955; **54,548**. Paid circulation of current issues; **57,300**. Recent readership research by Advertising Research Foundation shows 1.4 readers for every subscriber copy of AVIATION WEEK (readership determined by personal interview using strict recognition test). Current print order **60,670** copies.

Your advertising message scheduled for the April 23, 1956 issue will be timed to gain maximum attention from all those interested in the Air Transport industry. Regular advertising rates will apply.

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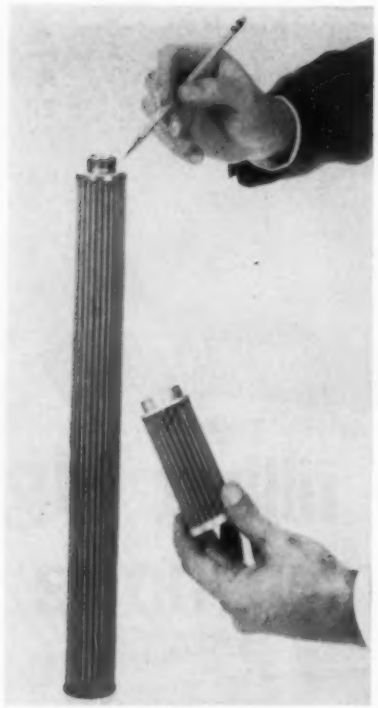


SINTERED METAL FILTER by Purolator removes particles as small as one micron.

cooling medium for the noses of unspecified guided missiles. Company officials say they also have a request for a porous cone for supersonic wind tunnel experiments and an order for jet engine combustion chamber liners. The latter structure will probably be reinforced with a perforated backing.

Aircraft Porous Media says its porous sheet metal, made of stainless steel or other heat-resistant materials, are being tested in transpiration cooling applications for jet engine combustion chambers. The company points out that the transpiration technique requires only a fraction of the coolant needed for external cooling of a solid wall.

Rigimesh has also been used for both combustion chamber and afterburner liners. In the latter use, bleed air is fed from outer surface inward to form a thin, cooling film on the afterburner wall.

APM has supplied porous metal strips to be used as leading edge anti-icing strips (anti-icing fluid is oozed or hot air is blown through the porous metal to prevent ice from forming).

To take stock of the existing problems in aircraft hydraulic systems, Cuno made a comprehensive engineering and market survey among aircraft hydraulic engineers. Three-quarters of the engineers questioned thought that incorporation of a magnetic feature in a hydraulic filter would be an important asset.

Some estimates that were made concerning hydraulic filter operating parameters:

- **Flow:** 12-gpm. is the immediate requirement for main hydraulic system filters; 24-gpm. units will be next on the list.
- **Pressure:** 3,000 psi. will be standard for current designs; 4,000 and 5,000-psi. systems are being tested experimentally.
- **Temperature:** 300F in 1956, 400F by 1957, and over 500F by 1960.
- **Degree of filtration:** 10 microns today, progressing as rapidly as possible to 0.5 micron, which will probably be the standard by 1960. To achieve this degree of filtration with acceptable pressure drops is a major problem.

Hydraulic System Trends

Significant trend noted by Cuno is the incorporation of filters in the hydraulic valves to be protected. This gives vital units such as servo valves and actuators the positive protection they must have in order to operate.

Several other advantages accrue from having built-in filters: Since flow through any individual valve is small, filters can be small and light; by having the filter in the component being protected, chances of the fluid becoming contaminated between the two units is virtually eliminated.

There is a growing need for 0.5-micron filters because hydraulic servos and actuators are being designed with lap fit-type tolerances, either to avoid use of packings because of heat deterioration, or to reduce leakage for very high efficiency. To operate correctly, such components must have almost clinically clean fluid.

Magnetic Filters

Cuno claims to be the first to develop an effective combined porous metal-magnetic filter. The unit substitutes porous iron for stainless steel and includes Alnico 5 ring magnets in the stack of filter cells. An electro-formed, pure nickel screen shroud is wrapped around the cells to provide a return path for the magnets' flux path. Thus, the shroud serves the dual purpose of closing the magnetic loop and providing a coarse strainer in the path of the influent fluid. Result is that the filter has the low pressure drop of a 10-micron unit, yet it effectively strains out submicronic, colloidal iron particles. The porous iron removes non-magnetic contaminants, such as bronze and stainless steel particles and extruded pieces of packing.

Magnetic filters are already at work. Cuno says that Westinghouse's Air Arm Division has tested the units and is now purchasing 0.5-gpm. capacity filters as production items for use in an autopilot for a classified missile. Bigger, 3-gpm. magnetic filters have been sold to Douglas and North American. In the 8-gpm. range, Cuno says that it is working on prototype quantities for Republic and California Institute of Technology.

Poro-Klean

Cuno engineers say they have developed advanced methods of controlling the porosity of stainless steel filters, assuring production of uniform sintered porous metal components.

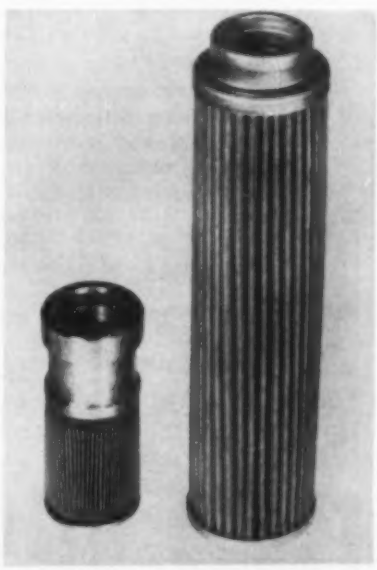
Poro-Klean filters resist the corrosive action of most chemicals, withstand temperatures exceeding 1,000F and differential pressures up to 2,000 psi.

Corrosion resistance is important because it allows the filter element to be cleaned by immersion in nitric or other acid to assure complete cleanliness.

Ten-micron Poro-Klean filters in the 6 and 12-gpm. capacities are interchangeable with cartridges which accepted the pleated paper units; this makes retrofit programs possible. The new porous metal filters were made to fit although the actual filtering element is considerably smaller than the paper unit it replaces. Similar-capacity 2-micron units and small 0.5-micron units are being tested by a large airframe manufacturer. Still other units are being proposed for the Vanguard Satellite missile—to General Electric, which will make the first stage, and to Aerojet, which will make the second stage. In the latter application, the filter would operate in propyl nitrate.

For Testing Fuels

A large jet engine builder was faced with the problem of determining jet fuel compatibility with its latest two turbojets. Part of the task involved preheating fuel to 500F and pumping it through a porous medium which would



SINTERED WIRE unit (left) has 3-gpm. capacity, same as larger paper unit.

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pick up tars, gums or other oxidation products resulting from the pre-heating. Quality of the fuel can easily be determined by checking the deposit build-up rates versus pressure drop.

Cuno says that when the engine manufacturer first started these tests with porous disk from another supplier, the disk acceptability figure was less than 20%. First Cuno disks were 50% acceptable. When a new powder-separating technique for the sintered metal was adopted, acceptance rose to 90%, and went to 100% when Cuno started to pretest them before delivery.

To obtain porous metal with very uniform flow rates, the company's engineers developed a way of segregating the metal powder received from suppliers. As they put it: "We separate the 'three dimensional ink spots' from the spheres. . . . By using spheres only, we obtain material of much more uniform porosity than had we used all the powder indiscriminately."

A significant part of Cuno's development is in filters for atomic engines. The company believes that, by merging its nuclear energy experience with its Poro-Klean endeavor, it will accumulate an excellent background to enable it to make filters for atomic-powered aircraft.

Aircraft Porous Media

APM spokesmen have also staked a claim in both the porous metal and wire screen filter fields.

They claim that their porous metal material, having a void content of 50%, gives a 400% higher flow for a given particle size removal or filtration efficiency than competitive porous metal filter elements. Also, they can manufacture the porous sheets in sizes up to 18x72 in., (basic size is 18x48 in.) or even larger, if the sheets are butt-welded together. Welded seams are non-porous and are about ⅝ in. wide.

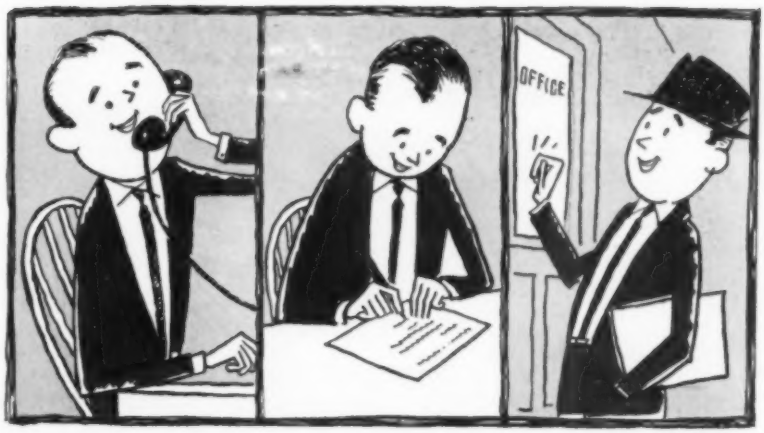
A newcomer to the field of metal filter material is Rigimesh, recently developed by the Pall company.

One of its latest applications is in a filter for Boeing. In a single unit, it filters down to 5 microns, withstands 5,000-psi. pressure and operates at 900F.

Principal advantages of the material:

- **Pressure drop of 1½ psi.** initial, compared to over 5 psi. for sintered metal or paper filters.
- **Temperature effectiveness** down to −50F. Pall says other types of filters cut off around −20F because increasing hydraulic fluid viscosity causes excessive pressure drop in porous metal filters and tends to collapse paper units.
- **Weight and space saving of** approximately 50% because filters can be made so much smaller than porous or paper filters for comparable fluid flows.

Here are comparative data on standard 3-gpm. resin-impregnated paper and Rigimesh filters, both of which meet



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Paper unit: weight, .06 lb.; volume, 4.2 cu. in.

Rigimesh unit: weight, .05 lb.; volume, 0.7 cu. in.

(Filter elements only were considered without housing.)

Pall says this small size is reflected in a weight saving of 20 lb. on the F-105 and 15 lb. on the F-107.

Unusual feature of Rigimesh filters, according to Pall, is that he can guarantee that the filter will remove 100% of all particles above a certain size.

Today, he can guarantee the removal of all particles above 22 microns. This is important because sheer force required for a valve spool to operate against a particle increases rapidly with the size of the particle. A servo valve might operate satisfactorily if it were subjected to a few 20-micron particles, but a single 50-micron particle might be fatal.

Other features of Rigimesh filter include:

• **Complete freedom** from media migration. Pall points out that paper filters can shed fibers; even porous metal filters units may lose some of the sintered metal powder into the hydraulic system. Rigimesh cannot, because there is nothing to come off.

• **High reusability factor** of the wire screen construction. It cannot disintegrate and can easily be cleaned either by back-wash or by immersion in boiling caustic soda or nitric acid or both. (It is not always possible to clean porous metal filters by back-washing, and acid cleaning in the field may be impossible.)

Great strength of Rigimesh construction allows the units to withstand over 3,000 psi. differential pressure.

Purolator officials say their extended-area-principle, pleated stainless steel filter is being tested by many airframe manufacturers. One model, a 3-gpm. unit capable of filtering to 5-8 microns and operating at 1,000F, has been ordered in production quantities.

J. P. Kovacs, vice president-research and development, told AVIATION WEEK:

• **Pleating the sintered** filter element in many folds allows the filter to provide a large filtering area in a minimum of space and weight.

• **Sintering together** the stainless steel top, bottom and porous filter element results in a high-strength one-piece unit which, by incorporating pipe thread fittings, eliminates the need for any type of O-ring or seal. This allows the filter to operate at 1,000F.

• **Eliminating welding** and screw machine parts and keeping number of parts to a minimum makes the filters appreciably lighter than other sintered metal filters, cutting the price in about half.

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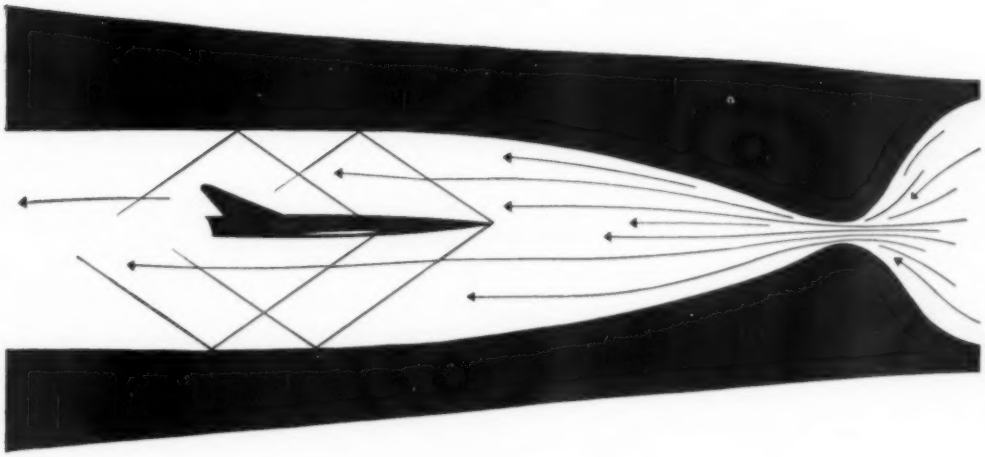

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G-E Servo-temperature Indication Systems Chosen by Convair for Navy Turbo-prop R3Y

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New General Electric Systems Have Expanded-scale Dual Repeater Indicators; Give High-accuracy Temperature Readings for Both Pilot and Flight Engineer

FIRST OF ITS KIND on any operational aircraft, the G-E servo-temperature indication installation on the R3Y includes eight amplifiers, one for each turbo-jet, eight two-inch master indicators for the flight engineer, and four three-inch dual repeater indicators on the pilot's instrument panel. Systems report turbo-jet temperatures simultaneously to both pilot and flight engineer.

EASY TO READ expanded scale used on G-E temperature indicators lets flight personnel read engine temperatures quickly. This avoids the difficulties encountered in reading two-scale or sub-dial type indicators. G-E dual pointer indicators save valuable space on pilot's instrument panel; give two readings on the same instrument. High accuracy of G-E servo-temperature indication systems helps assure optimum engine performance, lengthens engine life.

AVAILABLE IN MANY OTHER TYPES, General Electric servo-temperature indication systems can provide signals for control initiation proportional to temperature, time over temperature indication, or for dual repeater indicators.

EXPANDED SCALES used with G-E systems allow high-accuracy temperature readings in critical ranges.

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FOR FURTHER INFORMATION on G-E servo-temperature indication systems or on any G-E aircraft instrument, contact your nearest G-E Apparatus Sales Office or write Section 586-3, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

New Control Unit Eases Landing Chores

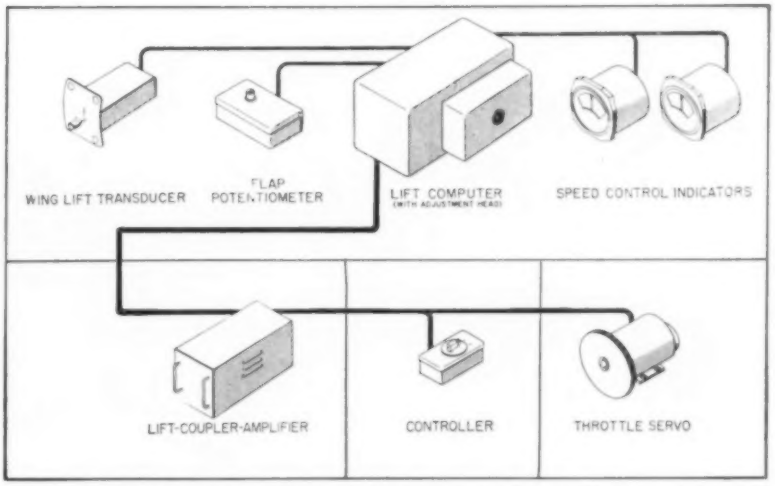
By Philip J. Klass

Overburdened pilots may soon be offered some measure of relief during the approach stage—particularly under instrument conditions—by a new system that automatically adjusts the engine throttle position and keeps the aircraft at any desired percentage above stall speed.

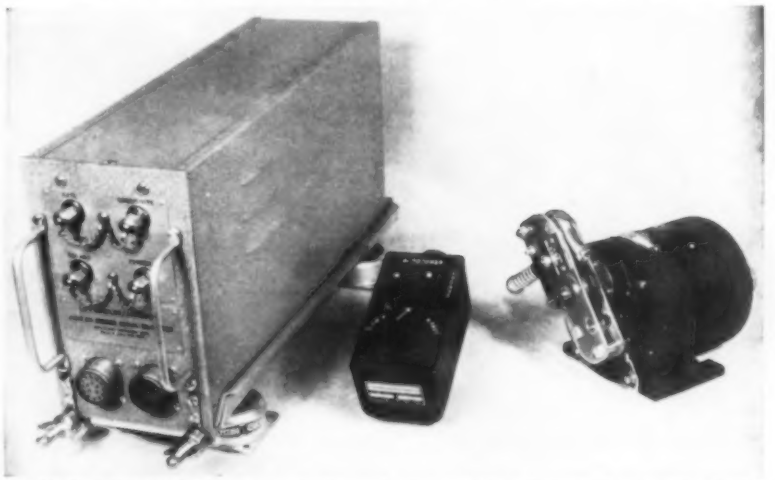
Labeled Autopower by its designer, the Safe Flight Instrument Corp. of White Plains, N. Y., the system is aimed towards the business aircraft, airline and military markets. It is an automatic version of the firm's well-known Safe Flight Indicator which gives the pilot a visual indication of his speed margin over stall condition, regardless of aircraft gross weight, acceleration, power, CG location, speed or flap/landing gear configuration.

The heart of the new Autopower system—and of the Safe Flight Indicator—is a small vane located on the wing, which measures the location of the stagnation point (the point where the airstream divides between the upper and lower portions of the wing [AW May 25, 1953, p. 67].)

The basic Safe Flight speed control system, which gives the pilot a visual indication of his speed margin, weighs six lb. and costs approximately $700. By adding a coupler-amplifier and an electric throttle servo, at a cost of about $5,500 and 36 additional lbs., the speed control system becomes the new Autopower system.



AUTOMATIC THROTTLE CONTROL, which adjusts engine power to hold speed at desired percentage above stall, employs original Safe Flight stall-point indicator (top) plus . . .



COUPLER-AMPLIFIER, pilot's controller and servo, which automatically operate throttle.

IATA Recommendation

During last year's special meeting of the International Air Transport Assn. on the subject of instrument approach and landing, the importance of airspeed stability and low approach speeds was emphasized. The report of that meeting stressed the desirability of "making every effort to reduce current approach speeds, because any such reduction will almost certainly have direct bearing on approach success." It continued:

"Although it would appear operationally desirable to use an approach speed with an agreed margin over stalling speed, it was pointed out that pilots in general tend to carry large pads of excess speeds in the interests of aircraft stability on the approach. This, however, increases their difficulty during transition and landing.

"The question was asked whether, given automatic throttle control, this tendency could be eradicated. It was the consensus that, provided pilots had confidence in the particular 'black box,' and could override its signals if necessary, they would be willing to use the optimum approach speed on all occasions and therefore derive considerable help from its use."

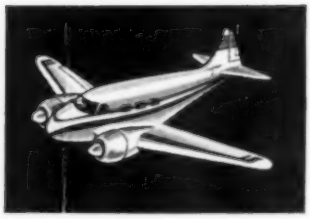
Idea Not New

Automatic throttle control is not a new concept. Almost all the major autopilot manufacturers have carried out such developments for their military equipments. When the Sperry A-12 and Eclipse-Pioneer autopilots were introduced for airline use after the war, throttle control was offered as an optional feature.

Airlines and pilots, however, were slow at that time to accept autopilots and automatic approach couplers, being reluctant to entrust vital functions to electronic devices. Automatic throttle control achieved even less acceptance for similar reasons.

But now, with higher-performance aircraft, the immediate prospect of jetliners and the parallel need for lower minimums, the airlines are showing considerable interest in autopilots and approach couplers. This suggests that the time may be ripe for automatic throttle control.

Previous attempts at automatic throttle control generally have used airspeed or angle-of-attack sensing units, with



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Avionics Division

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throttle position being automatically adjusted to maintain the desired airspeed or angle of attack. Safe Flight Instrument Corp. officials believe their patented stagnation-point sensor provides a more suitable and responsive reference for automatic throttle control.

For example, when flap position is changed or landing gear lowered, the optimum airspeed or angle of attack may change.

This is not so, however, with the optimum stagnation point location, according to SFI officials.

This means that the SFI Autopower system requires no adjustments or changes throughout the approach. To illustrate, if the system is set to maintain 115% of stall speed, it will do so within several percent despite changes in aircraft configuration. A small controller allows the pilot to change the percentage of stall speed to a slightly higher or lower value.

Recent flight tests by a West Coast aircraft manufacturer on a large piston-engine transport have, SFI officials say, confirmed this claim. The manufacturer's flight test report concludes: "The release of pilot attention from airspeed and throttle adjustment for each approach configuration makes an automatic flight path control system (autopilot) more automatic . . . (allowing) the pilot more time to monitor the approach and the various instruments which are necessary for safe landings."

Performs Like Pilot

Safe Flight has designed its Autopower system to perform its tasks much like the human pilot. Response of the system to small, slow changes in airspeed is relatively slow, while it reacts more rapidly to sizable or rapid changes in speed. Maximum servo speed is such that it requires about nine seconds to move the throttle from closed to full power position.

The throttle servo is designed to permit the pilot to override it at any time, and it can be disconnected by means of a pushbutton mounted on the control column.

SFI has tested its new system on the company's Twin-Beech and DC-3 for more than a year. Two Autopower systems are being readied for flight test by the USAF's Wright Air Development Center, while a third is scheduled for evaluation at the Navy's Patuxent (Md.) base.

Eclipse-Pioneer Flight Systems for American

Eclipse-Pioneer's new PB-20 transistorized automatic flight control system, including flight director, has been selected for use by American Airlines on its new fleet of Lockheed Electra turboprops.

Portrait of **one** engineer doing the work of **two**

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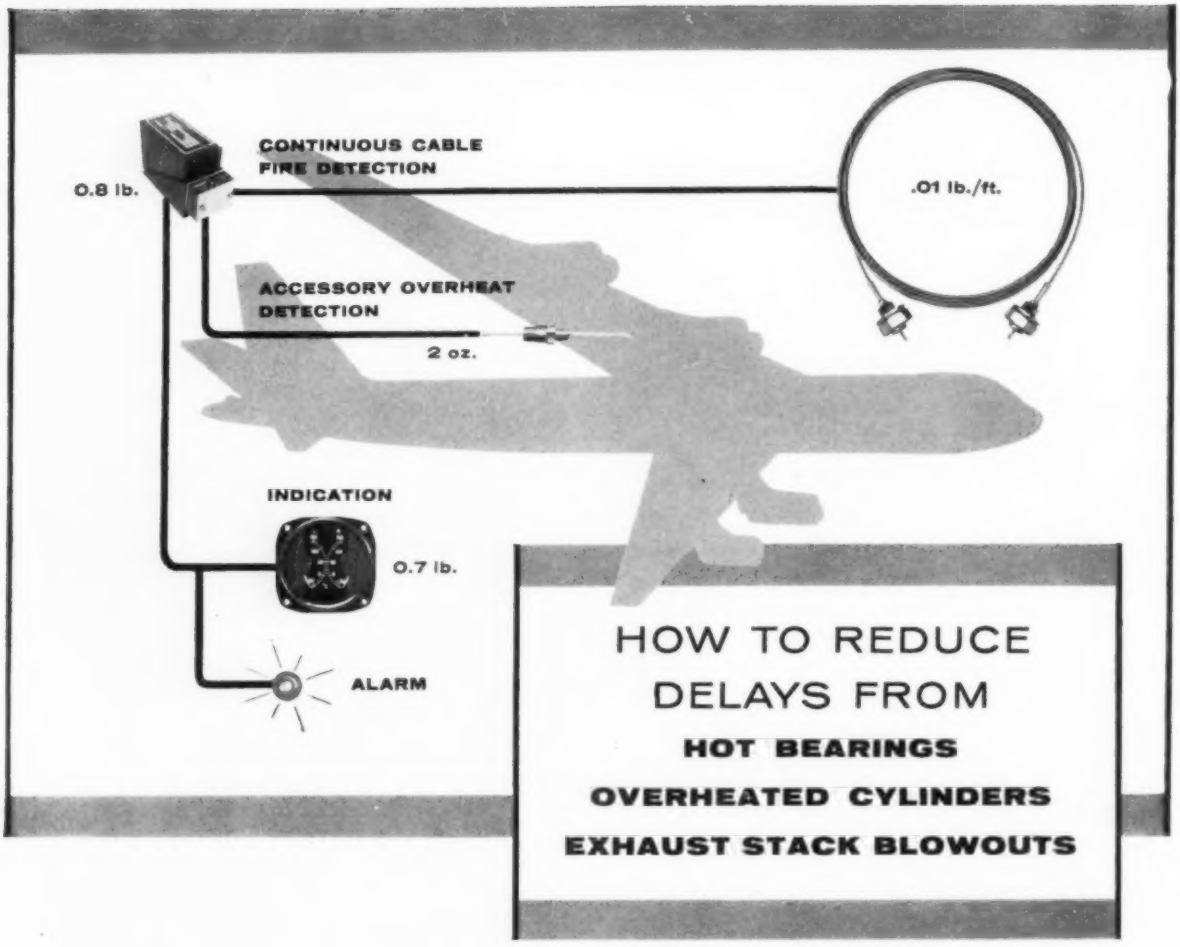

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New Transistors Seen At IRE Convention

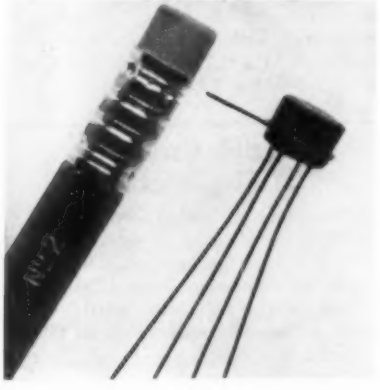
The development of a rash of new transistors and other semiconductor devices have been announced recently. Many of them were scheduled for display for the first time at last week's Institute of Radio Engineers convention in New York.

General Electric has announced seven new semiconductor devices, one of them an entirely new device known as a silicon double-based diode. Four of GE's devices are housed in an entirely new button-type container, which the company says is under consideration for possible industry standardization. The new GE semiconductors include:

• **High-current silicon rectifier,** Type ZJ 15, occupies only 1 cu. in., including mounting stud, but can handle 50 amps forward current per cell at 200

volts, peak inverse voltage with maximum rated stud temperature of 150C. Device is hermetically sealed.

• **Double-based silicon diode,** a microsecond switch having regenerative switching action between its two stable states, is a three-terminal device rates for 100 mw. dissipation at 85C and maximum storage temperature of 200C. Device also can be operated as an astable, monostable or bistable multivibrator



or sawtooth generator. Operating temperature range is −65C to 160C and rise time is 1.5 microseconds.

• **Silicon power transistor,** Type ZJ 16, an alloy junction p-n-p type, can dissipate 8 watts at 85C, 4 watts at 120C. Maximum collector voltage is 75 v., alpha cutoff frequency is 100 kc., and maximum storage temperature is 200C.

• **Germanium tetrode transistor** has alpha cutoff of 50 mc. at 85C. Device is rated at a minimum of 10 db. power gain at 30 mc. and 25C, with a 2 mc. bandwidth. Device can dissipate 50 mw. at 25C and has a rise and fall time of 0.02 microseconds.

• **High frequency silicon transistor,** Type ZJ 12, n-p-n type, has a 6 mc. alpha cutoff, 15 db. power gain at 2 mc. Power dissipation is rated at ¼ watt at 25C.

• **High frequency germanium transistor,** Type ZJ, a rate-grown n-p-n device, has an alpha cutoff of 15 mc. Power gain is 12 db. minimum at 5 mc., rise and fall time is 0.5 microseconds.

• **Low-current silicon rectifier,** Type ZJ-18, delivers 250 ma., over temperature range of −65C to 150C without employing heat sink. Maximum peak inverse voltage is 200 v. Other recently announced semiconductors include the following:

• **Silicon power rectifiers,** Types 1N503

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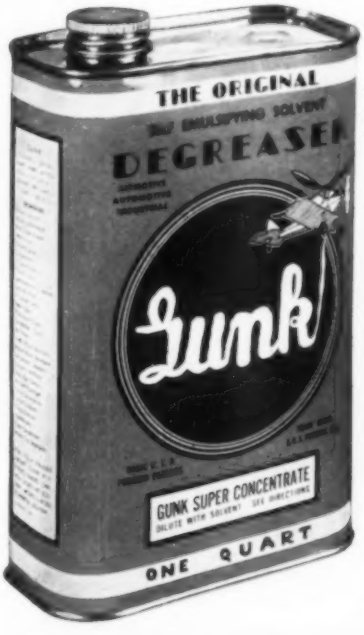

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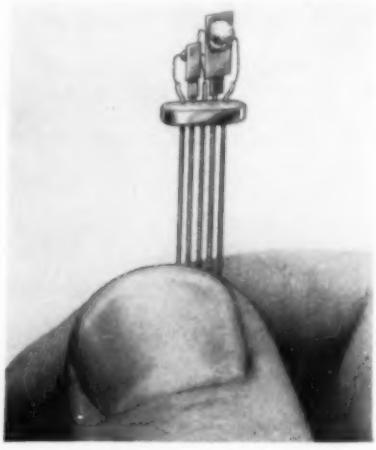
through 1N526, can be operated at 125C, and deliver ½ to 1¼ amps, depending upon the type. Engineering data Sheet E-263 gives application information. Manufacturer also has announced two new germanium p-n-p junction alloy transistors, Types 2N180, 2N181, for general purpose, low frequency use. Collector dissipation is rated at 150 mw. for the 2N180, 250 mw. for the 2N181. Data sheet E-264 gives application information. Manufacturer: CBS-Hytron, Danvers, Mass.

• **Tandem transistor,** Model MT-1, consisting of two d.c. coupled transistor elements connected to form a two-stage cascade within a single container, provides a high current/power gain de-

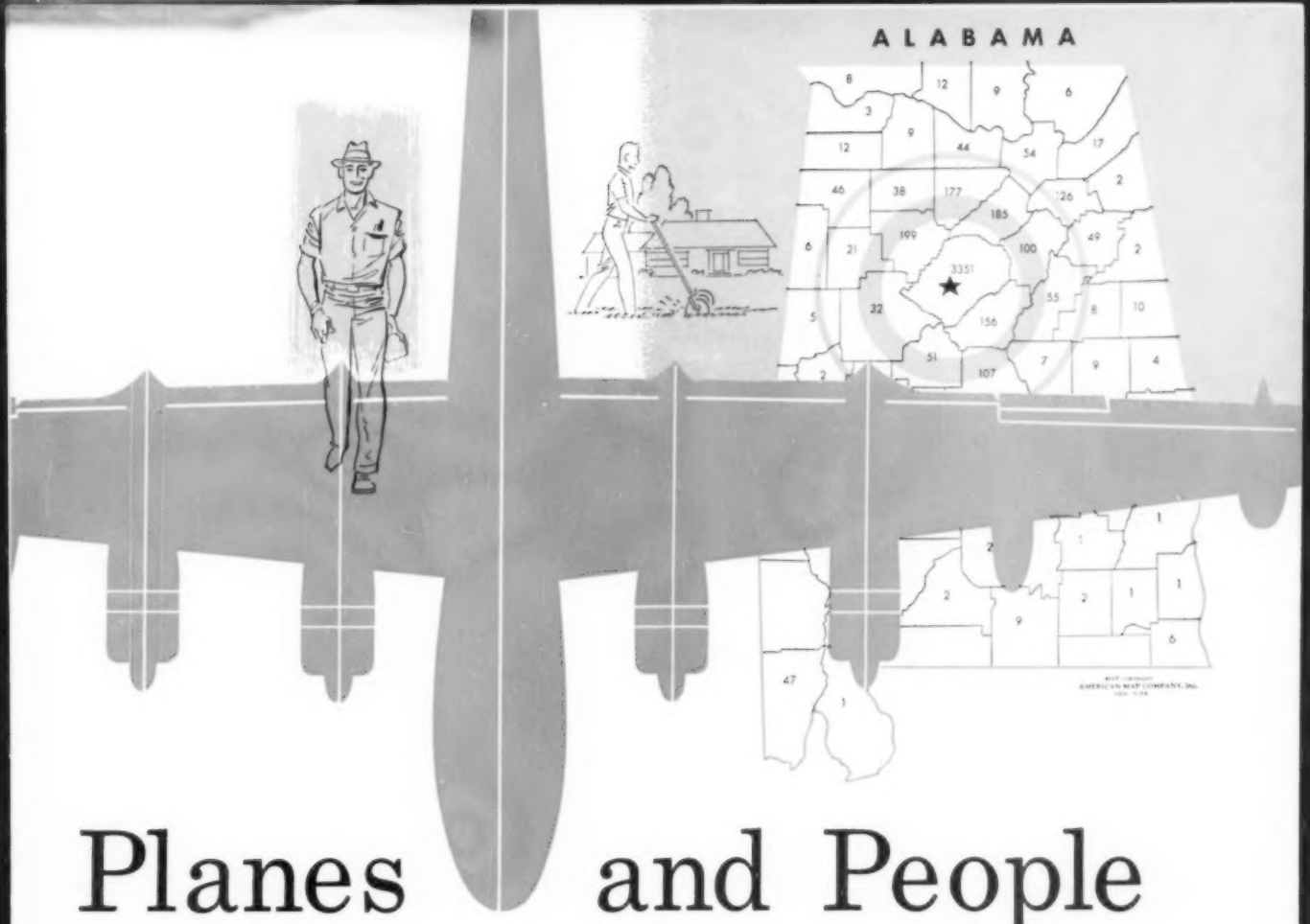


vice with a high ratio of input to output resistances. Manufacturer: Marvelco Electronics Div., National Aircraft Corp., 3411 Tulare Ave., Burbank, Calif.

• **Bonded silicon diodes,** eight new types with peak inverse voltage ratings from 15 to 225 v. New models are Types 1N300A, 1N301A, 1N302A, 1N303A, 1N432A, 1N433A, 1N434A, and 1N460A. They are similar to units without the "A" designation, except that they have higher forward current ratings with no increase in reverse current. All types are hermetically sealed, can be operated at ambient temperatures of −55C to 150C. Volume is less than 0.01 cu. in. Manufacturer: Raytheon Manufacturing Co., 55 Chapel St., Newton 58, Mass.

Inertial Guidance Reprints

The supply of reprints of the inertial-guidance system series by avionics editor Philip J. Klass has been exhausted. To meet the continuous demand, an additional order is now being printed, and still unanswered requests will be filled shortly.



Planes and People

Great credit is due Hayes Aircraft employees for their part in the operation of this southern aircraft company. Their skill, their interest and initiative, largely determine the difference between mediocrity and excellence in the performance of aircraft work.

Hayes workers are alert, ambitious and intelligent. They can think! They accept responsibility. They like their jobs, take pride in their work and are loyal to their employer. They believe in the principle of cooperation between Labor and Management.

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*Background map indicates distribution of Hayes employees' homes. A recent personnel survey shows that approximately 3,450 employees live within 25-mile radius of the plant; 1,450 live between 25 and 50 miles away; 600 live between 50 and 100 miles away.

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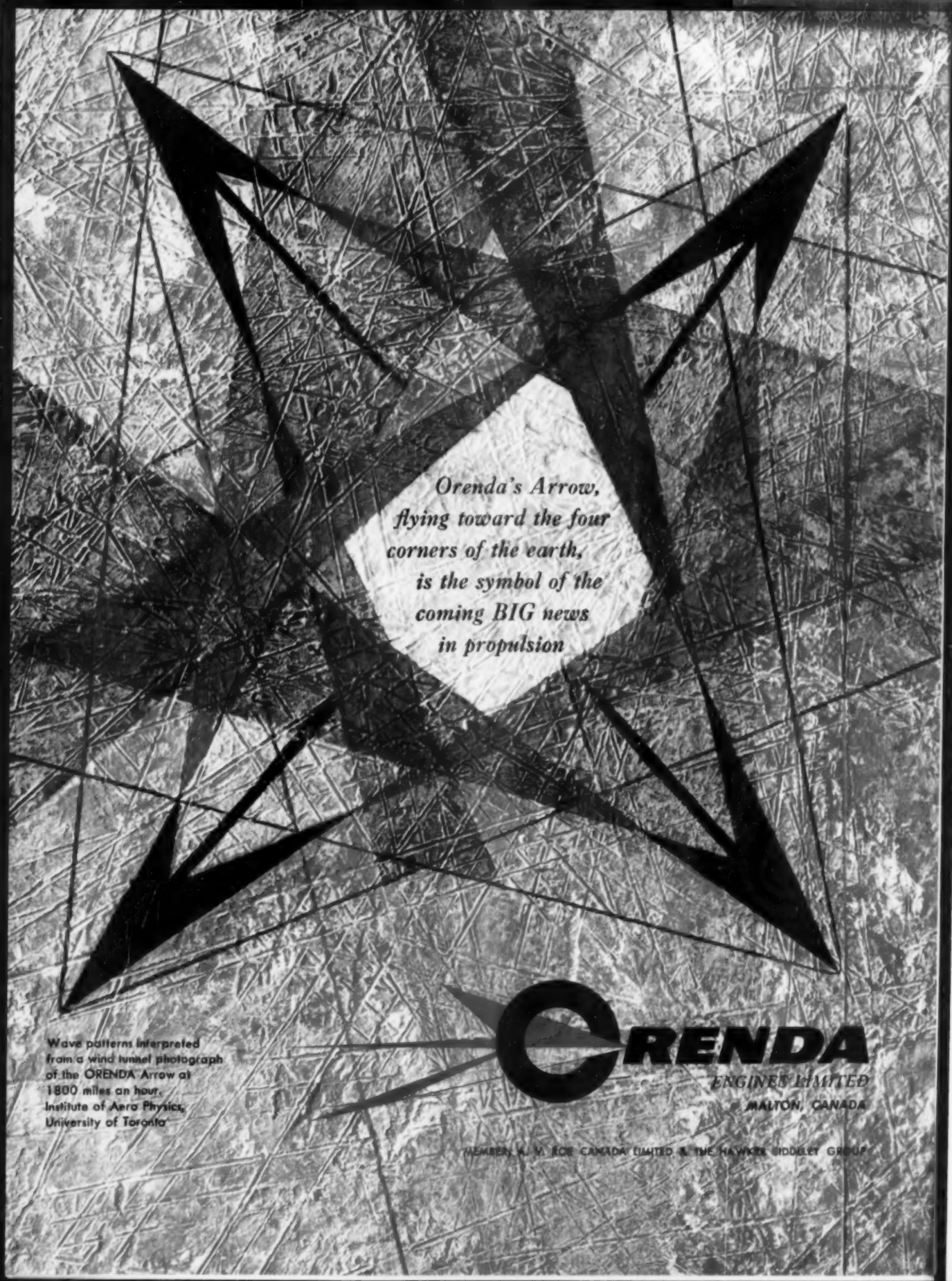
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Expansions, Changes In Avionics Industry

Beckman Instruments, Inc., Fullerton, Calif., has announced the establishment of the Shockley Semiconductor Laboratory, headed by Dr. William Shockley, inventor of the junction transistor and former Director of Transistor Physics Research at Bell Telephone Laboratories. The new lab, which will develop and produce transistors and other semiconductor devices, will be housed in a new building, slated for completion this August, in the Stanford Industrial Park, near Stanford University.

Other recent expansions and changes in the avionics industry include the following:

• **Emerson Electric Manufacturing Co.,** St. Louis, is expanding and changing the name of its former Armament Division to Electronics and Avionics Division.

• **Allen B. DuMont Laboratories, Inc.,** Clifton, N. J. has formed a new Missile Engineering Dept. which will be responsible for the firm's missile activities. Company plans to expand its missile activities with the addition of increased facilities at its new West Coast headquarters in Los Angeles.

• **Motorola, Inc.,** will expand its military electronics engineering and production facilities in Phoenix, Ariz., with a new $3 million 150,000 sq. ft. building, bringing its total facilities in that area to 325,000 sq. ft. When this addition, and Motorola's new transistor plant are in full operation, by the end of this year, total company employment in the area will be approximately 3,000, roughly double the present figure.

• **Roger White Electron Devices, Inc.,** Ramsey, N. J., maker of microwave equipment, has purchased a new plant at Haskell, N. J., which will triple present facilities.

• **Astron Corp.,** East Newark, N. J., maker of capacitors and RF noise filters, has purchased the Skottie Electronic Corp., Inc., Peckville, Penna., maker of ceramic capacitors.

• **National Aeronautical Corp.,** (Narco), Ambler, Penna., maker of private plane and business aircraft avionics equipment, has broken ground for its new 25,000 sq. ft. plant in the Ft. Washington Industrial Park. Occupancy is expected this Summer.

• **The Narda Manufacturing Corp.,** Mineola, N. Y., is the name of a newly formed subsidiary of The Narda Corp., which will manufacture UHF and microwave test equipment for government use.

'Darkroom' Liners

Microwave energy absorbing material for use in lining radio-radar "darkrooms," can be used at frequencies of 50 mc. and higher. Energy dissipation of the new Eccosorb CHW 560 is quoted at 1½ watts per square inch and reflectivity at less than 2%. Material comes in 50-inch square panels consisting of two fitted wedges. Manufacturer: Emeson & Cuming, Inc., 869 Washington St., Canton, Mass.

FILTER CENTER

► **New Publications Of Interest**—Newly available reports and publications of interest to persons in the avionics field include:

• **"Proceedings of the RETMA Symposium on Automation,"** 114 pages, paper bound, is available for five dollars from Engineering Publishers, GPO Box 1151, New York 1, N. Y.

• **"Worldwide Radio Noise Levels Expected in the Frequency Band 10 kc. to 100 mc."** published by the National Bureau of Standards is available from the Government Printing Office, Washington 25, D. C., for 30 cents. Ask for NBS Circular No. 557.

• **"The Summary of Registered Crystal Diodes,"** a new publication listing diodes which are registered with the Joint Electron Tube Engineering Council, is available for one dollar from the Radio-Electronic-Television Manufacturers Association, 11 W. 42nd St., New York 36, N. Y. Ask for JETEC Publication No. 3A.

► **Oops!**—The angular mil/nautical mile counter, suitable for use in navigation equipment, described in the Feb. 27 issue, p. 91, is manufactured by the Bowmar Instrument Corp., 2415 Penn. St., Ft. Wayne, Ind. The firm's name and address were inadvertently omitted from the original item.

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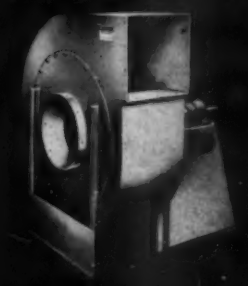

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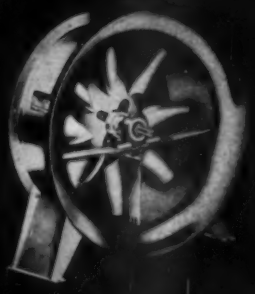

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RCA, Litton Report Increased Profits

Both the Radio Corporation of America and Litton Industries are reporting increased sales and profits.

RCA, whose gross business topped $1 billion for the first time in Fiscal 1955, reports that approximately 22% of its sales went to the Armed Forces. Based on sales of $1,055,266,000, up 12% from 1954, this would place RCA's military business at around $232 million.

RCA profits before taxes were $100.1 million, an increase of 20% over 1954, with profits after taxes of $47.5 million, up 18%. Year-end backlog of Government business was $235 million, roughly a full year's work at last year's rate.

Litton reports that its profits for the six months ended January 31 totaled $442,000, an amount greater than the total profits for the entire preceding year. Sales for the same period were $7 million, more than double the volume of the same six-month period in the previous year. Backlog of work under contract and in final stages of negotiation has reached $31 million, Litton reports. This figure includes a recent $5.6 million USAF award for large pulsed klystrons for use in the early warning radar network.

NEW AVIONIC PRODUCTS

Instrumentation

• **Multi-channel tape recorder,** Model TR-150-5, offers three recording speeds of 15, 30, and 60 in./sec., with frequency response flat within 3 db. between 200 cps. and 20 kc. at tape speed of 15 ips., or between 100 cps. and 80 kc. at 60 ips. Stopping time is 0.1 sec. at all speeds, starting time varies between 1 and 5 sec., depending upon tape speed. Flutter and wow are quoted

at under 0.1% from 0 to 300 cps. Telectro Industries Corp., 35-16 37th St., Long Island City 1, N. Y.

• **Multi-channel data reduction system,** called Datrac C, provides simultaneous sampling and digital conversion of 18 channels of analog voltages into magnetic tape or IBM punch cards. Input voltages can be from 10 mv. to 1,000 v., full scale. Overall system accuracy

is 0.1% absolute, 0.25% relative. Up to 180 data points per second can be converted. Digital output for tape recording consists of sign plus four decimal digits in and 8-4-2-1 binary decimal code, with parity check and sprocket pulse. Epsco, Inc., 588 Commonwealth Ave., Boston 15, Mass.

• **RF amplifier,** Model 1460, supplies 15 watts RF power into a 50-ohm load over frequency range of 200-250 mc., with no more than 2 watts input power. Amplifier requires external source of 400 v. d.c. and 6.3 v. a.c. or d.c., measures 5x4¾x3½ in., weighs 27 oz. Operating temperature range is 40 to 185F. . . . Model 1461-A VHF-FM transmitter delivers 25 watts over frequency band of 215-235 mc. It is designed for FM or PDM modulation and will produce a maximum deviation of 125 kc. at output frequency. Unit measures 5⅞x3½x4 in., weighs 34 oz. Telechrome, Inc., 632 Merrick Rd., Amityville, N. Y.

Components & Devices

• **Slide-on microminiature coaxial connector,** for applications which require "blind engagement" of the two halves of the connector, is available in a complete series of 50, 70, and 93-ohm impedances. Microdot, Inc., 1826 Fremont Ave., So. Pasadena, Calif.

• **Miniature uncased Mylar capacitors,** available in either flat or round form factor, can be operated over a temperature range of −65C to 200C. Units reportedly meet MIL-C-91A environmental requirements, come in working voltages of 50 to 600 v., with standard tolerances of 0.5 to 5%. Insulation resistance at 150C is over 300 megohms-mfds. Free samples are available on request. Capcon, Inc., 25 Willett St., New York 2, N. Y.

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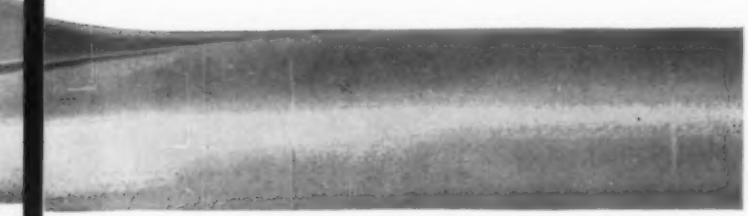

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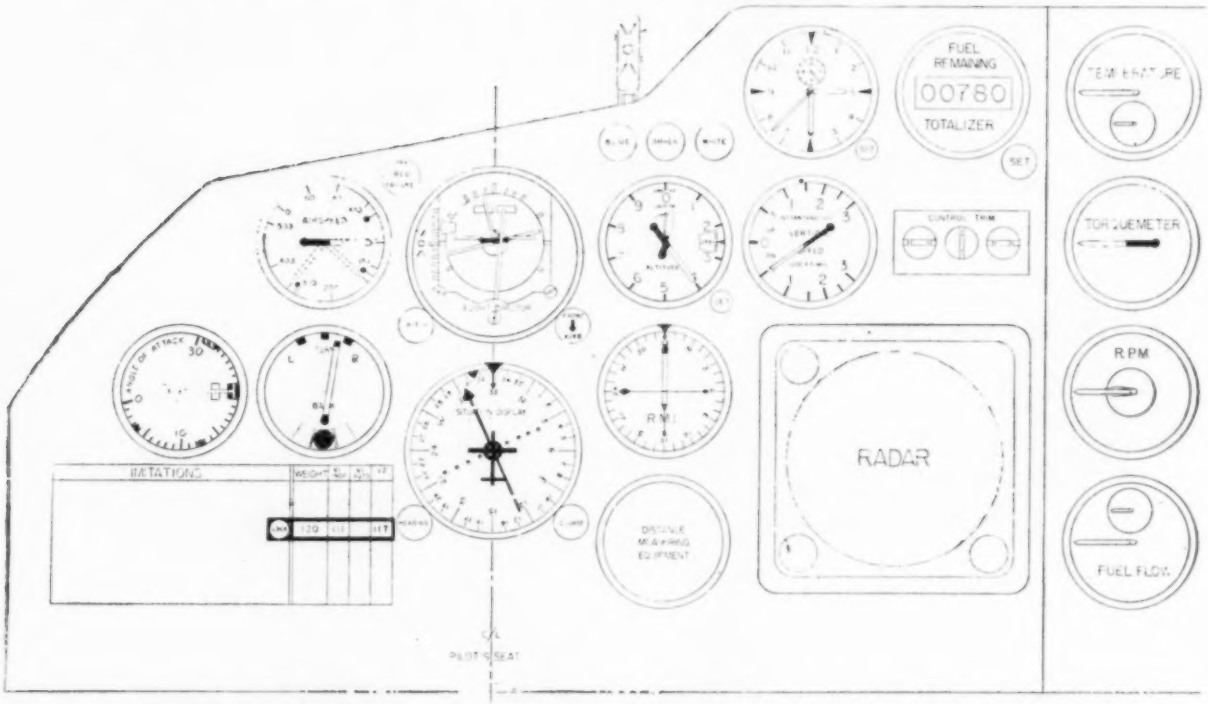


AIRLINE PILOTS RECOMMENDED this layout of instrument panel for the Lockheed Electra.

How Electra Instrument Panel Will Look

Layout devised by pilots and accepted by American; wide approval would be step toward standardization.

By Preble Staver

The Lockheed Electra turboprop transports on order by American Airlines will incorporate a new cockpit layout and flight instrument panel arrangement. It represents cockpit instrumentation designed for and recommended by the men who use it—the pilot and co-pilot.

The idea for the Lockheed Electra flight instrument panel came from the Lockheed Electra Airplane Evaluation Committee of the Air Line Pilots Assn. Its chairman was AAL Capt. Charles H. Daudt and membership was comprised of pilots whose airlines are ordering the Electra. American Airline's management was the first to accept the pilot's recommendations.

What the pilot has been wanting, Capt. Daudt told AVIATION WEEK, is a flight instrument panel that is the ultimate in simplicity and effective presentation. The group's proposal, he said, is backed up by an average of 20 years experience each in observing the behavior of flight instruments. Daudt pointed out that the ALPA group's work also included evaluation of integrated flight instrument systems. He said that he and other pilots who have flown in an aircraft outfitted with presently available equipment arranged in the presentation desired, rate both highly.

The cockpit instrumentation finally selected as the pilot's choice was dictated by a design philosophy of placing the basic flight instruments on the panel in the most prominent position and then arranging in the most efficient manner the reference instruments so that they may be monitored by horizonal instead of vertical scanning.

Flight Director Is Key

The accompanying illustration of the Lockheed Electra Flight Instrument Panel shows that the Flight Director has been placed at the focal point on the panel. All other flight instruments have been given horizontal and vertical proximity to the Flight Director in the order of relative importance during flight-maneuver.

This allows the least margin for error or slow reaction time.

The Flight Director has, at last, provided a single instrument for giving complete attitude and steering information.

It is the pilot's opinion that the first interest is to keep airborne, and the second is to travel in the right direction.

The group therefore recommended positioning the Flight Director in the top line of instruments, directly in front of the pilot and control column. It further suggested an instrument face designed to present the best possible pictorial display of the airplane's attitude, both en route and in approach flying.

The predominantly central location chosen for the Flight Director also allows the greatest number of reference or assist instruments to be grouped around it within the minimum scanning distance.

Located immediately to the left and

right are the airspeed and altitude instruments. An inverter or alternator failure warning light is positioned just above and slightly left of the Flight Director.

To most logically associate altitude information with marker lights indications, the three marker lights are aligned horizontally above the altimeter (with blue-amber-white from left to right).

Instrument Positions

Immediately to the right of the altimeter is the instantaneous vertical speed indicator. This instrument, reflecting pitch attitude, is placed next to the altimeter, since any deviation from its zero or "9 o'clock" position of the needle indication is immediately reflected by an increase or decrease in altitude.

Directly below the top horizontal line of instruments is the second line, indicating the aircraft's attitude.

The pictorial-type course indicator instrument with an integral compass card was selected for the second most predominant position on the panel, beneath the Flight Director and directly in front of the pilot and control column. Navigational reference and assist instruments are close by. The dual RMI is located to the right and the Turn and Bank indicator to the left. Further left of the turn and bank indicator is the Angle of Attack indicator. The distance measuring and bearing indicator (DME) has been placed below the RMI.

To the right of the RMI and DME, and below the Instantaneous Vertical Speed indicator, space has been provided for the radar. This is on the captain's panel only. On the co-pilot's panel, the radar is positioned to the left of the Turn and Bank indicator. The location of both radar scopes requires looking downward. The belief is that this may be helpful in avoiding flash-blindness. It also frees the more prominent panel positions for the more-often-used instruments.

Stop-Clock

A three-inch clock with "stop movement" has been positioned immediately above the Vertical Speed Indicator. This position was chosen for two reasons. It puts the clock in close proximity to the altimeter, with which it will be associated in "holding stacks, jet penetrations, and instrument approaches," the group said. It is also in immediate proximity to the Fuel Remaining Totalizer for quick association of those two readings, so vitally related in jet engine operations.

The Fuel Remaining Totalizer is to the right of the clock. In the available space below the totalizer and to the right of the Vertical Speed Indicator is the Control Trim Indicator, in a position that is considered relatively important.

The cockpit instrumentation as described is the pilots' current best thinking on the presentation that should be made with instruments currently available. They believe that ready industry acceptance of such a layout will mean a step forward in efforts to standardize flight instrument panels. It follows that a standard arrangement which would be equally desirable and familiar to all pilots would provide one of the greatest flight safety contrivances yet devised.

Sir Miles Leaves BOAC

London—Sir Miles Thomas, who lifted the British Overseas Airways Corp. into the black, announced his resignation last week from the $21,000-a-year post as chairman of the airline's board.

Sir Miles refused to comment on the reasons behind his resignation, but a BOAC spokesman described the move as "purely personal." There also was no immediate indication as to when a successor to Sir Miles will be named or just where he will go. Last fall, however, he accepted a part-time director's position with Harry Ferguson Research Ltd., developers of the revolutionary Ferguson car.

Under Sir Miles' leadership, BOAC managed to shake off government subsidy and keep its books in the black, although in 1949 when he assumed the chairmanship, the airline was showing an annual loss of $22.4 million.

Western Air Strike Ends After 63 Days

Los Angeles—Struck 63 days by one union and in negotiations simultaneously with two others, Western Air Lines will resume full operations this week with signed agreements with all three.

A contract with the striking Brotherhood of Railway Clerks gave personnel covered raises averaging $30 monthly but omitted the asked-for union shop clause.

The Air Line Pilots Association pact provides a 4% pay increase encompassing a supplemental variable annuity type pension plan. The raise is retroactive to May 1, 1955, while the pension plan starts April 1, 1956.

Another agreement was made with the International Association of Machinists (AFL-CIO) covering the line's mechanics. The contract provides nine cents an hour raises retroactive to Oct. 21, 1955, and an additional nine cents an hour increase to begin on Nov. 1, 1956.

Mohawk Buys Seven Swissair Convair 240s

Mohawk Airlines has bought seven Convair 240 transports from Swissair in a major expansion of the local airline's present mixed fleet of Convairs and DC-3s.

The American carrier has purchased Swissair's entire Convair fleet, and the deal includes the complete spare parts inventory and accessories. The contract, subject to Civil Aeronautics Board approval, calls for delivery of the seven transports between August and December of this year, depending on when Swissair gets the eight Convair Metropolitans it has ordered.

Mohawk didn't disclose the purchase price of the Convairs, but the company has plans for additional equity financing and renegotiation of current bank credit agreements to cover the transaction.

The package deal includes nine newly overhauled Pratt & Whitney R-2800 engines and propellers and an inventory of plane and engine parts.

Mohawk's president Robert E. Peach said his company feels the Swissair Convairs represent the lowest time (an average of 10,000 hours per ship) and the best maintained fleet of modern short-haul pressurized transports available. Mohawk will modify their passenger door installation to make them identical with its present fleet.

The local airline plans to put two of the Convairs in service as soon as they are delivered, and will complete the step door modification so that four of them will be in service by next spring.

Mohawk doesn't know right now how many of the Swissair Convairs will be added to its present fleet of four Convair 240s and 11 DC-3s. The decision hinges on CAB action on Mohawk's application for non-stop Syracuse-New York service and for a Buffalo-Erie-Detroit route.

Mohawk said its studies indicate there is a strong market for lease or sale of any Convairs it can't use when they are delivered and that negotiations are under way with operators interested in leasing Convairs that are surplus.

Northwest Plans New Minneapolis Facility

A $15,000,000 facility for Northwest Orient Airlines will be built by the Minneapolis-St. Paul Metropolitan Airports Commission for lease on a self-liquidating basis. The 800,000-square-foot structure will contain an overhaul base, line maintenance shops and general offices.

Work on the Northwest facility will begin next fall at Minneapolis-St. Paul International Airport. Completion is scheduled for late 1957.

IDLEWILD "CROSSROADS," center of picture, is formed by intersection of three runways. Flush lights will bridge intersection gap.

Idlewild Installs New-Type Runway Lights

By Glenn Garrison

New York—Preparations for the first U. S. test of the Elfaka flush-type runway light are under way this week at New York International Airport where 12 units in two bi-directional clusters will be installed at the intersection of three of the airport's runways (see picture above).

Air Force, Civil Aeronautic Administration, Defense Department and Air Transport Association are observing the experiment with the Dutch-produced system.

While the Idlewild installation is the first in this country, Elfaka lights have been in service for several years at several Dutch and Danish airfields. They came close to entering service in this country last year when the CAA and Air Force included an Elfaka installation in initial plans for approach light tests at McGhee-Tyson Field in Knoxville, Tenn. The plan was finally abandoned, however, because of the prohibitive cost (AW Dec. 5, 1955, p. 131).

Idlewild Test

The Port of New York Authority is footing the bill for the New York installation, which has been placed in the crossroads formed by Runway 4-22, Runway 1-19 and Runway 7-25 near the middle of the airport. Like runway intersections generally, this one is now served by elevated lights off the intersection and necessarily out of line with the other boundary lights.

The primary purpose of the Idlewild test, according to the Port Authority, is to evaluate the lights not so much from an illumination standpoint—which can be pretty well predicted beforehand—but to determine how they hold up under heavy intersection traffic and how easy they are to maintain.

The installation consists of two bi-directional "clusters" of Elfaka units (six lamps to a cluster) set into what would be the two edges of instrument Runway 4-22 if it were not interrupted at the intersection.

The Idlewild installation has been delayed until three days of good weather are in prospect in order not to tie up three runways for so long a period during poor weather.

Future Plans

If the tests are favorable, the Port Authority hopes to find other uses for flushlighting. At Idlewild, for example, they might be used in connection with the planned second instrument runway there.

The new runway could be built, contingent upon a number of if-factors, to incorporate the concept of runway lighting known as narrow gage all-weather lighting: basically a track of light down the center instead of the edge lighting.

The present Idlewild installation was tailored specifically to Port Authority specifications by Structural Concrete Products Corp. of New York City, the U. S. licensee and manufacturer of Elfaka lights.

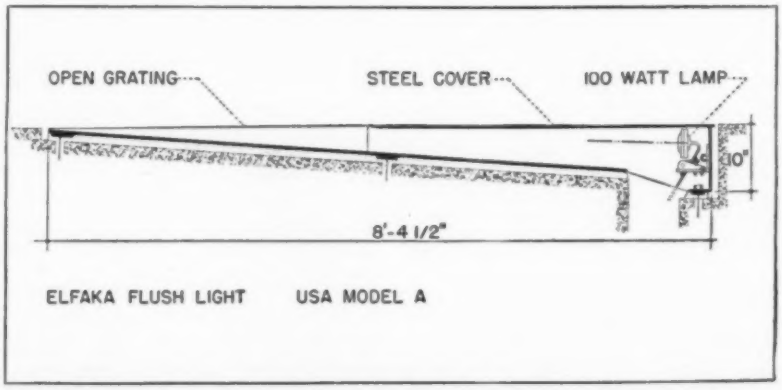
Structural Concrete, a firm with extensive experience in prefabricated Air Force buildings, became interested in the Dutch lights a few years back, arranged the licensing agreements and has since been trying hard to get the CAA, Department of Defense or the Air Force to test their re-designed American product.

The Port Authority asked for lights that could be seen from 1,200 feet, with the lane as much as 50 feet off the centerline on the side of the light; on the side opposite the light, from 500 feet away when 25 feet off the centerline.

Horizontal spread of the beam required by these specifications is 12½ degrees (the runway is 200 feet wide, its boundary lights of 230-ft. gage).

Installation

To fit the unusual requirements of the location, Structural Concrete installed six lights on each side, three of each set back to back with the other three to provide a beam each way. Each group of three units is fanned slightly



PROFILE SKETCH shows re-designed version of Dutch-designed flush runway light.

to provide the necessary spread of the beam.

Structural says it could have come up with a single unit with necessary spread, but the expense wouldn't have been practical for the experimental installation.

While the Idlewild installation fails to provide a good cost barometer under the circumstances, the units ran about $300 each including transformer, for a total of $3,600. The big item—installation in the concrete—is being done on a cost-plus basis, and the Port Authority hasn't estimated the cost.

Design Changes

Structural Concrete has made some major changes in the Dutch design of the Elfaka lights. While the original lamp was hermetically sealed in a box at one end of the unit, the new unit is a sealed beam lamp easily accessible for replacement.

And, whereas the Dutch unit involved a continuous grid over the pit from the lamp box to the end of the unit, the first four feet of the American design is covered by a solid plate.

The plate increases the structural strength and also allows a light beam of higher intensity (there is less grill to interfere with the light).

The grid itself has been re-designed for much greater strength, and Structural Concrete says it can support tire imprint pressure up to 250 pounds per square inch. This takes care of the weight of anything now around or likely to be in the immediate future, including the Douglas DC-8 and Boeing 707 jet transports, and can be beefed even further to handle the latest fighter planes.

The grill openings have been reduced so they are 1⅛ in. at their maximum width, narrow enough not only to reject airplane tires but also the casters of snow plows.

Interest in Lights

Interest in the Elfaka lights in this country was first directed towards their use in "overrun" areas in the approaches to joint use runways. Their American licensee, however, hopes eventual civil and military uses will include approach lighting, various types of runway lighting and taxiway lighting. For approach installations, Structural Concrete says it may be able to add condenser discharge "flashing" lights in a flush configuration.

The cost of flush type lighting is, of course, a major problem. While widespread use would bring costs down, the installation expense cannot be avoided.

Building the lights into new runways, however, would be much less expensive than sinking them into existing strips.

ASME Hears:

Salesmanship Dearth, Not Aircraft Block Air-Cargo Industry Growth

Los Angeles—Lack of salesmanship is the greatest obstacle to the growth of the air cargo industry, Thomas J. Harris, director of cargo sales for American Airlines told air cargo specialists here for the Aviation Division Conference of the American Society of Mechanical Engineers.

"Let us not fool ourselves," Harris said, "that it is the need of a 'true' cargo aircraft that will solve our problems in this business. It is the economic ignorance of our industrial management in terms of its distribution costs and the relationship of those costs, one to the other, that has to be cleared."

Harris cited the recent Twentieth Century Fund study which showed that 59 cents out of every dollar goes toward the cost of distributing goods as contrasted to the cost of producing them."

He said transportation itself, along with such items as marketing, are housing, insurance, financing, materials handling, taxes, packing and obsolescence makeup the distribution cost.

The barrier of getting the shipper to appreciate the inter-relationship between transportation and these other functions of distribution, has to be broken Harris warned. He added:

"Our first job is to know enough about these production and distribution and inventory management problems of a firm to intelligently determine whether or not airfreight will permit a reduction in inventories and, in those cases where it will permit a reduction, to calculate the extent of that reduction."

Growth of air freight business has been projected to between 640 million to 800 million ton-miles annually by 1965 and to realize this business, Harris said, it is important to "understand and measure the costs of distribution together with the proper examination of sales opportunities in terms of break-even analysis.

American Starts New DC-7 Coach Service

American Airlines will upgrade its aircoach services this spring with the inauguration of DC-7 Royal Coachman flights between New York and Los Angeles and Washington and Los Angeles.

American will use an 85 passenger all-coach DC-7 in the new service, contrasting with the combination class Super-G Constellation flights offered by Trans World Airlines.

Meals will be served on the DC-7 flights. Fare for the service is $99.

American plans to inaugurate service between New York and Los Angeles on May 20 with two nonstop flights a day in each direction, scheduled for eight and a half hours westbound and seven hours and 45 minutes eastbound. The Washington-Los Angeles service is scheduled for June 17 with one round-trip nonstop flight a day. The Washington route is scheduled for eight hours westbound and seven hours and 25 minutes eastbound.

Three-Cent Airlift Experiment

Los Angeles—The need for larger subsidies from Congress to keep the Post Office Department abreast of the times in handling airmail was voiced by E. George Siedle, Assistant Postmaster General, at the Aviation Division Conference of the American Society of Mechanical Engineers here.

The three-cent airlift experiment, initiated October 1953, has been successful, Siedle said, and has advanced delivery of some of the mail as much as 48 hours over surface transportation. The future of this type of speeded-up mail service faces obstacles, he added, that only legislation, more funds and cooperation between all transportation agencies can solve. Siedle said present needs include:

- **Legislation that will provide full authority for the Post Office to select the most economical and most expeditious mode of transportation.**
- **Congressional provision of the necessary funds to do that kind of job.**
- **Friendly cooperation of all transportation agencies and the commissions that regulate them.**

So far, as the future is concerned, Siedle said, "any diversion of mail to air from surface transportation media—even though the volume is but a small percentage of the total—will be resisted and draw vigorous objections from those losing traffic. . . . Yet the volume of letter mail that could be diverted is only about 1/30 of the tonnage handled by rail."

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PAA Campaigns for Great Circle Route

Washington—Pan American World Airways has opened its formal battle for a Great Circle route in the reopened transpacific renewal case with a voluminous presentation to the Civil Aeronautics Board.

The exhibits filed by Pan American precede formal hearings on the case, now scheduled to begin May 8. At issue is PAA's application to operate between the West Coast and the Orient via the Great Circle route now flown by Northwest Airlines. President Eisenhower has asked the CAB for new recommendations on the controversial issue, held over when the rest of the case was decided a year ago.

Pan American told the Board that the air travel market in the Pacific is much larger and more stable than it was in 1952 when original hearings were held on the transpacific routes. PAA attributes this to the decrease in military operations and introduction of tourist service in the area, and the return of relations between the U.S. and Japan to a more normal status.

According to the PAA presentation, the present Pacific market is two and one half times the size of the market considered in the original case. The airline points out that it carries more than half the passengers flown across the Pacific and maintains that these passengers are inconvenienced by the requirement that PAA make a stop in the Central Pacific.

Competitive Disadvantages

Pan American contends that this restriction not only puts it at a competitive disadvantage with Northwest, but also weakens the carrier's position in competing with the foreign airlines.

Both Northwest and Pan American began operating without subsidy in the Pacific last year. A key factor in this improvement was the shifting of military mail to commercial carriers. Pan American says that Northwest's faster routing is causing the Post Office Department to shift mail traffic to the point where PAA is carrying only 25% of the total. The airline says that this trend is forcing it back on subsidy, and it must have a competitive routing to regain its share of the mail traffic and stay off subsidy.

An important factor in the decision on the Great Circle route will be the operating capabilities of the DC-7C, the first transport with sufficient range to be a prospective nonstop operator across the Pacific. Northwest Airlines has eight of the Douglas transports on order, and Pan American's Pacific Division is supposed to get eight of the 33 DC-7Cs ordered by PAA. The new plane will be delivered this year.

Pan American told the CAB that modifications of the DC-7C now under negotiation will allow the airplane to raise its percentage of nonstop completions to at least 75%. PanAm said that when jet transports become available, 100% nonstop operations will be routine.

Judd Defends Northwest

Northwest's position in the case has been defended by Rep. Walter H. Judd (R.-Minn.) in a speech in the House of Representatives. Judd said the only decision which would not violate all reason and fairness is a denial of Pan American's application.

He said "the only question the Civil Aeronautics Board now has before it is whether or not to allow the clearly dominant carrier, showing substantial earnings from its lush route across the central Pacific, access also to the lean route and smaller market served by its much smaller competitor. If Pan American is granted access to the northern route and permitted to increase its earnings by diverting traffic from Northwest, then the government will be forced to underwrite the contribution to Pan American by placing Northwest back on subsidy to make up for the losses it certainly will incur."

The long-simmering controversy over the Great Circle route flared up again last January when the White House asked the CAB to bring the record up to date on Pan American's application for Great Circle authority between Toyko and Los Angeles, San Francisco, Portland and Seattle. The President deferred decision on this question when he issued his instruction in the transpacific renewal case last year.

The Board reopened the case, then decided to include the questions of a permanent certificate for Northwest and the addition of Los Angeles and San Francisco as coterminals on Northwest's transpacific route. CAB Chairman Ross Rizley dissented, maintaining that the President intended the case to be restricted to the Pan American application.

On Mar. 3, two days after the Board issued its order expanding the case, Rizley received a letter from the White House specifying that the case be restricted to Pan American's application and limited to developments in the past year which apply to the application. The CAB then reversed itself, excluded the Northwest applications, and limited the case to Pan American's request.

Subsequently, Northwest has asked the CAB to propose permanent certification for its international route on the grounds that it has gone off subsidy since the president denied permanency a year ago. At that time, the President said he thought permanent certification of Northwest was premature as long as subsidy was necessary.

Doolittle, M. Eisenhower Mentioned to Head TWA

Lt. Gen. James H. Doolittle (Ret.) and Milton Eisenhower, brother of President Eisenhower, are being mentioned by a leading Trans World Airlines official as choices for the TWA presidency to replace the late Ralph Damon.

Doolittle probably is not interested, having recently moved to San Francisco where he plans to retire from Shell Oil Co. in about one year. Choice of Milton Eisenhower would create an unusual situation, if he should accept. His son is employed by Pan American World Airways. A spokesman for TWA says that no action is expected on appointment of Damon's successor until the company's annual meeting scheduled April 26.

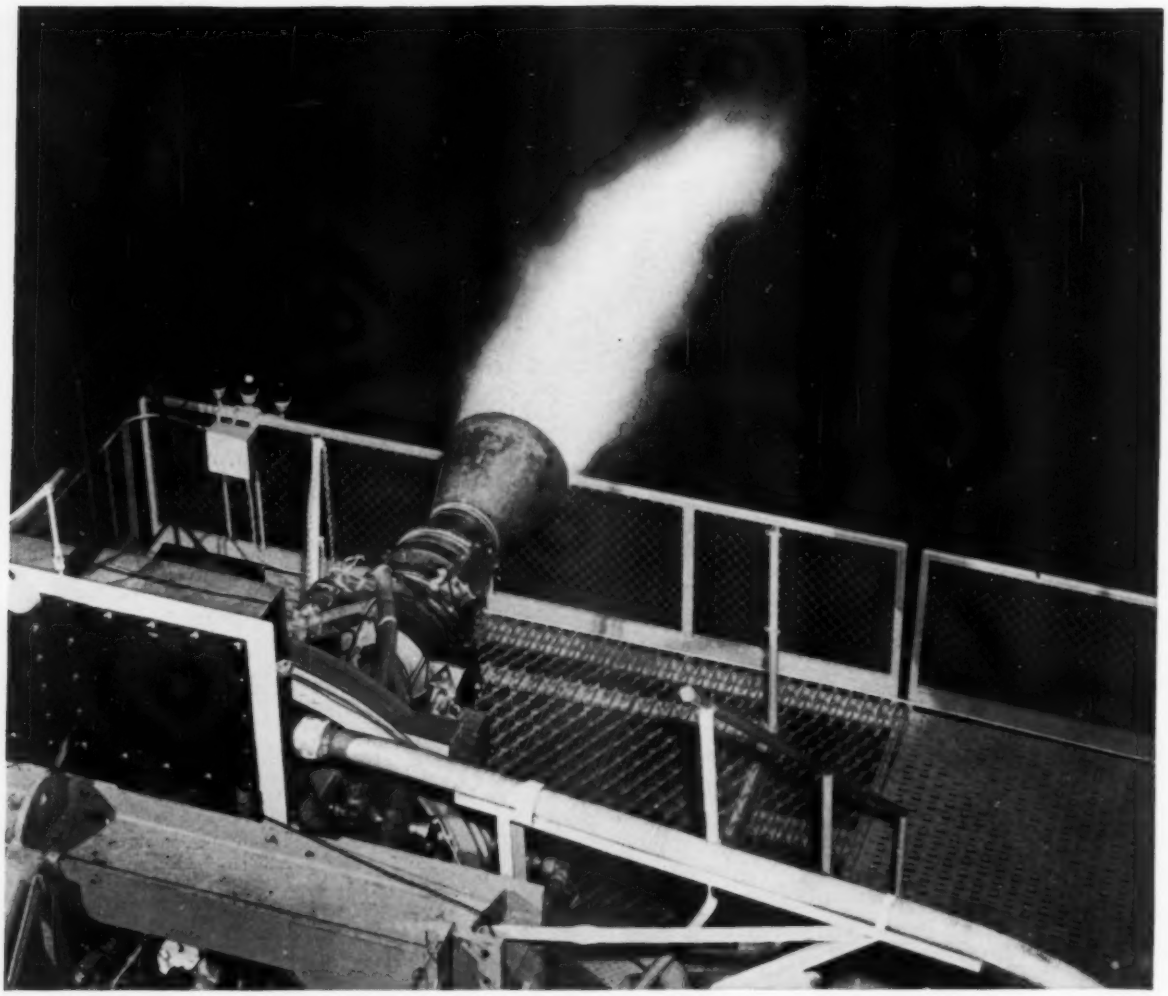
Braniff Shows Traffic, Revenue Gains in 1955

Braniff Airways continued to make steady traffic and revenue gains and had subsidy sharply reduced in 1955, a year the airline describes to its stockholders as a period of constructive preparations for the future.

Passenger revenue increased from $37.7 million in 1954 to $41.9 million last year. Total revenues increased only slightly from $45.9 million to $46.8 million, largely because mail income dropped from $5,147,460 in 1954 to $1,717,003 in the past year. Net income for 1955 was $1,668,398, compared with $3,712,313 the previous year.

Braniff flew 679,965,000 passenger-miles last year, an increase of 62,492,000 over 1954. Express and freight traffic increased from 5,253,744 ton-miles in 1954 to 5,787,058 ton-miles last year. Passenger load factor slipped from 59.56% in 1954 to 58.55% in 1955.

The Civil Aeronautics Board reduced Braniff's mail pay last year so that domestic operations were off subsidy after Jan. 1, 1955 and subsidy for international operations dropped from $2,319,335 in 1954 to $369,120 in 1955. The company said these subsidy reductions are a healthy thing despite temporary depression of earnings.



Night firing tests on early ROCKETDYNE engines helped speed the development of today's models whose power cannot be disclosed.

Today's Rocket Engine can send a missile half-way around the earth

Even as you read this, rocket engines capable of sending a guided warhead half-way around the earth are being developed and produced by ROCKETDYNE, a Division of North American Aviation, Inc. . . . and larger, still more powerful units are on the way.

Behind these bare facts is a 10-year story of how the Air Force and ROCKETDYNE faced up to one of the biggest engineering challenges of the last decade. Security restrictions do not permit us to give you the details, but we *can* tell you that ROCKETDYNE has manufactured the largest liquid-propellant rocket engine in the free world. ROCKETDYNE is developing and producing rocket engines for many of the major guided missile projects in this country.

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BUILDERS OF POWER FOR OUTER SPACE

ARTIST'S DRAWING of planned $10 million terminal at Miami International Airport.

Miami Building New Terminal For Growing Traffic to South

By Craig Lewis

Miami—Miami is building a new air terminal to handle the burgeoning passenger and cargo traffic traveling to and from Florida and Latin America.

The new terminal will cost about $10 million. Bonds to pay for the project already have been sold, and construction bids are being processed now by the Dade County Port Authority, the municipal agency which runs Miami International Airport.

The terminal is supposed to be ready to handle traffic by November, 1957. It will be built on the eastern portion of the airport in the area between the two main east-west runways and will replace the present facility, which has been far outstripped by Miami's air traffic growth.

Plane loading accommodations are designed to handle 53 aircraft simultaneously. The terminal area will include about 500,000 square feet and have 1,100 feet of ticket counter, 700 feet of baggage claim counter and 18 escalators. Parking will be provided for 2,500 automobiles.

Expandable Terminal

The Port Authority has designed the terminal so that it can be expanded at each end without interrupting service. It is estimated that when the terminal is completed, the 3,000 acre Miami International Airport will be worth at least $80,000,000.

Nonscheduled airlines are currently using a terminal on the site of the new facility.

They will move to the present main passenger terminal when the new one is completed. Construction plans call for the razing of 207 buildings on the terminal site, many of which have already been torn down.

The terminal project doesn't include any expansion of runway facilities. The field currently has four runways, the longest 9,400 feet. They are considered wide enough and heavy enough to handle the jets recently ordered by the airlines. Some new taxiways will be built to fit the new terminal into the runway system.

The construction plans do not interfere with any of the numerous airline maintenance facilities scattered around the airport.

Miami is a choice spot for the airlines to locate their shops because the mild weather allows more outdoor work than is possible in other parts of the country.

Gateway to South

Miami's traffic has increased substantially since World War II. The South Florida city is the major air terminal in an area which is in the midst of a development boom and has shown a steady increase in vacation business, especially in the formerly slack summer months.

Miami is also a key gateway to Latin America. Travel to Central America and South America has been increasing, and the Caribbean has shown steady development as a resort area. Air travel to these points has increased as their vacation facilities have grown, and Miami is the pivot point for all this travel to the south.

Miami International Airport ranked second in the nation in aircraft movements last year, with 276,729 landings and takeoffs.

It was first in the number of flights completed without interference from weather. Traffic has increased from 210,172 movements in 1950.

Passenger traffic hit 3 million in 1955, compared with 1 million in 1949 and 2.5 million in 1954. Air mail has increased from 6 million pounds in 1949 to 11.8 million pounds in 1955, and air express and freight is up from the 1949 total of 53.5 million pounds to 137 million pounds last year.

Passenger Volume

The ratio of increase in aircraft movements has not kept pace with the sharp upward trends in passenger and cargo traffic.

Airport officials attribute this to the fact that aircraft introduced in the past few years carry considerably more passengers and cargo than earlier types. It is estimated that, including visitors, the Miami terminals handle more than 30,000 people a day.

Airport revenues in 1955 totaled $2,814,890, an 8% increase, and operating expenses were $1,023,657, down 6.8% from the previous year. Income from parking, taxi and U-Drive-It concessions amounted to $261,701 last year, compared with $195,953 in 1954. The Port Authority expects to make over $300,000 from this source in 1956.

Southern Is Preferred For Panama City Route

Washington—Southern Airways has been chosen to operate a new air service between Atlanta and Panama City, Fla., by Civil Aeronautics Board Examiner William F. Cusick.

In his report on the Panama City-Atlanta case, Cusick recommended that the CAB certificate Southern to fly between Atlanta and Panama City via Columbus and Albany, Ga., and Dothan, Ala., for an experimental five year period. He also recommended skip-stop and non-stop authority for service between the two terminals.

The examiner found a definite need for direct air service between the two cities. Right now, the only air service available is via connections at Tallahassee, Mobile or Jacksonville, and National Airlines is the only carrier serving Panama City.

With proper promotion, the route should produce 12,000 to 14,000 passengers a year, according to Cusick. A key factor in development of traffic on the route is the attraction of Panama City as a resort area. Tourist business in the immediate beach area is estimated at $25 million annually.

While National offers east-west service to Panama City, the examiner finds a need for North-South service since present air service is circuitous and ground transportation is very slow.

In selecting Southern for the route,

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40 acres is now available just 40 minutes from the heart of downtown Los Angeles, adjoining the Ontario International Airport, and is zoned for operation of jet aircraft.

The airport has a 7,250 foot main concrete runway, with immediate planned expansion to 8,500 feet and two planned future extensions of 1,250 feet each. All taxiways and runways are concrete.

The airport has a C.A.A. instrument landing system, C.A.A. Control Tower and a fully automatic Weather Station, together with C.A.A. approved high-intensity lighting system.

The acreage is served by the Southern Pacific Railroad and located just 2,500 feet from the San Bernardino Freeway. Zoning will permit industrial, manufacturing or aircraft maintenance. All necessary utilities are available. This property is ideal for aircraft, avionics or electronics manufacturing facilities.

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Cusick rejected the applications of Eastern Air Lines and National Airlines. He concedes that the trunklines could offer better service to points beyond the terminals of the route, but he contends that the proposed route should be properly characterized as a local service operation. Cusick feels that long-haul questions involved in the trunkline applications are beyond the scope of the case.

The report finds that the addition of the Panama City-Atlanta segment would serve to increase Southern's average length of passenger haul and would offer the carrier an excellent opportunity to develop and promote traffic which would enable it to improve its financial position," Cusick said.

The examiner points out that "the very existence of the local service carriers is dependent to a large extent upon their being able to offer the public air transportation service between large trading centers such as Atlanta and smaller communities such as Panama City."

CAB Orders

(Mar. 8-14)

GRANTED:

Riddle Airlines an exemption to provide transportation between Detroit and Miami to D. Gilmartin and E. Lombardo of the Detroit News for news purposes, providing each person pays a roundtrip charge of $111.80.

United Air Lines an exemption to serve Milwaukee and Chicago or Detroit, or both, on the same cargo flight, and to originate and terminate cargo flights at Milwaukee, providing no local cargo traffic is carried between Milwaukee and Chicago or between Milwaukee and Detroit. The exemption is for one year or until 60 days after decision on United's certificate amendment application, whichever occurs first.

Continental Air Lines authority to omit service at Santa Fe, N. M., on all but one roundtrip flight daily over its Albuquerque-Clovis, N. M., route.

APPROVED:

Agreements involving Lake Central Airlines, Slick Airways and various other carriers relating to several intercarrier arrangements.

Agreements involving American Airlines, Central Airlines and various other carriers relating to intercarrier arrangements.

ORDERED:

North Central Airlines and Lake Central Airlines' applications to operate between Lima, Ohio, and Detroit via Toledo consolidated into the Lima-Detroit service case. Leave to intervene granted to Allegheny Airlines, Capital Airlines, Delta Air Lines, the Aeronautics Commission of Indiana, the Ohio Aviation Board and the City of Lima and Lima Association of Commerce.

DISMISSED:

Suspension and investigation of fares filed by Peninsular Air Transport between Miami and Philadelphia, Newark and New York, since the fares have since been cancelled.

Suspension and investigation of fares filed by Aero Finance Corp. between Dallas and Oakland, and between Miami and Newark, New York, Philadelphia and Washington, since the fares have been cancelled.

DENIED:

Motions of the City of St. Louis and the Chamber of Commerce of Metropolitan St. Louis, Braniff Airways and Trans World Airlines to expand the area of the Great Lakes-Southeast service case. The Board instituted a separate proceeding involving service between St. Louis and Florida and other southeastern points.

Northwest Airlines' application for exemption authority to carry local traffic between Great Falls, Mont., and Butte and/or Helena, Mont.

Tuya Cuban Express Corp.'s petition for leave to intervene in the matter of the application of Cuban Colonial Air Express Corp. for a foreign air carrier permit.

Petition for reconsideration of dismissal of a complaint alleging various discriminatory airport charges at Miami International Airport.

North Central Airlines and Ozark Air Lines' petitions for reconsideration of CAB action denying the carriers exemption authority to operate between the Quad Cities and the Twin Cities.

Shortlines

▶ **Air France** has started a new service in the Caribbean with three DC-3 flights a week scheduled between Ft. De France and Barbados. The French airline also has increased its weekly Boston-Paris nonstop Super-G Constellation service to two flights a week and will increase it to four weekly flights this summer.

▶ **Air Transport Assn.** reports the Airlines Clearing House handled $53,021,911 in January—19.5% more than January, 1955, business.

▶ **American Airlines** claims a new industry record with 69,482,000 ton-miles of air freight flown last year, 24% more than American carried in 1954.

▶ **Canadian Pacific Airlines** plans to extend its routes to Buenos Aires before the end of May with three weekly flights via Mexico City and Lima.

▶ **Capital Airlines'** travel agent sales increased 17% during 1955, and 1956 quotas call for a 60% increase. Capital attributes the sales increase to the popularity of the Viscount.

▶ **British European Airways** reports a profit of $2,413,600 in 1955 on total

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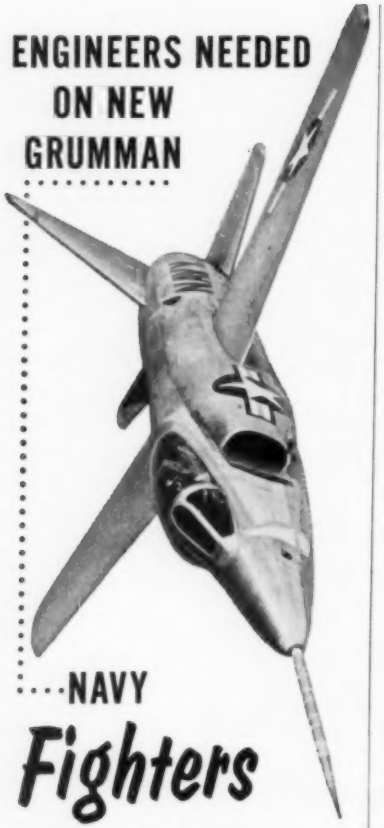

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revenues of $58,008,000. Revenues rose 24% during the year while expenses increased 17%. BEA carried 2,157,100 passengers in 1955 with a 70.2% load factor.

► **Flying Tiger Line** reports an 85% gain in gross revenues and a profit of $660,773 for last six months of 1955. Revenues were $10,886,299 and traffic increased 101% to 30,903,701 ton-miles of air freight. January traffic was 4,824,804 ton-miles, a 75% increase over the previous January.

► **India** has refused traffic rights at Bombay to Air Ceylon on its Colombo-London route. The Indian government says it will review its decision when it is convinced that substantial ownership and effective control of Air Ceylon lies with Ceylonese nationals as stipulated in the India-Ceylon air agreement. Air Ceylon is linked with KLM Royal Dutch Airlines in an arrangement which gives the Ceylonese airline 51% of the stock.

► **Panagra** will equip five tourist class DC-6Bs with Bendix airborne radar. The carrier says the radar program is the result of previous success with the equipment on its DC-7Bs.

► **Pan American World Airways** will send 25 technicians to Thailand for three years to help Thai Airways develop and expand the country's air transport system. Pan American is working on the $2 million program in conjunction with the International Cooperation Administration . . . PAA flew 653,000 pounds of cargo across the Atlantic in January, a 61% increase over January, 1955 traffic.

► **Sabena Belgian World Airlines** will operate ten DC-6 flights a week between Brussels and New York this summer . . . Sabena will expand its helicopter service to Dortmund, West Germany, Apr. 22. The Belgian carrier plans to begin using the Sikorsky S-58 this summer.

► **Silver City Airways** carried 58% of the air freight handled at all British airports last year and claims that its 1955 lift of 72,333 tons makes it the world's largest carrier of air freight.

► **Swissair** has decided to increase its share capital from $3,263,403 to $9,790,209 to meet the requirements of recent jet orders . . . Swissair's revenues for 1955 were $30,256,410, 17% more than 1954 income. Expenses were $29,883,440 and net profit $367,693 in 1955.

► **Swissair** is offering three tours to Russia from New York via Vienna. The tours, arranged through the Cosmos Travel Bureau and Intourist, cover such points as Moscow, Leningrad, Kiev, Rostov and Belgrade and range from $979.35 to $1206.95 during the off season.

► **Trans World Airlines** added Cairo and Athens to its intercontinental Super-G Constellation service Mar. 3. By Mar. 8, TWA will have increased its Super-G combination class service across the Atlantic to 24 flights a week. . . . TWA will offer over 6,000 seats on 100 flights a week between the U. S. and Europe this summer with 88% of the capacity in tourist seats.

► **Transocean Air Lines** has set up overhaul operations at Honolulu to handle F-86 fighters belonging to Hawaii Air Guard.

► **Trans World Airlines** averaged a 23% increase in passenger traffic between Jan. 1 and the first week of March . . . TWA has increased nonstop Super-G Constellation service from St. Louis to New York and Los Angeles to 12 flights daily and will start a direct service from St. Louis to Europe Apr. 29 . . . TWA is moving into its new $5.5 million engine overhaul shop at Kansas City Mid-Continent International Airport this month.

► **United Air Lines** will start the first nonstop service between Washington and San Francisco Apr. 29 with a daily first class DC-7 flight. United began operating an overnight nonstop DC-7 service called the Starlight Continental between New York and Los Angeles Mar. 1 . . . United flew 291,986,000 passenger-miles in February, 17% more than the previous February.

► **United Air Lines** will increase the capacity of its all-cargo fleet 70% with the delivery of five DC-6As this spring and summer.

Lufthansa Purchases Vickers Viscount 810

Deutsche Lufthansa, the West German airline, announced an order last week for the Vickers Viscount 810 to be used over planned routes between Europe and the Middle East.

Seven to nine of the new-model turboprops, which have a top speed of 360 mph. and a seating capacity for 63 passengers, will be delivered to Lufthansa, beginning with three in late 1958 and the remainder in 1959.

The carrier plans to begin its Middle East service, routed through Munich, in September with Lockheed Super G Constellations.

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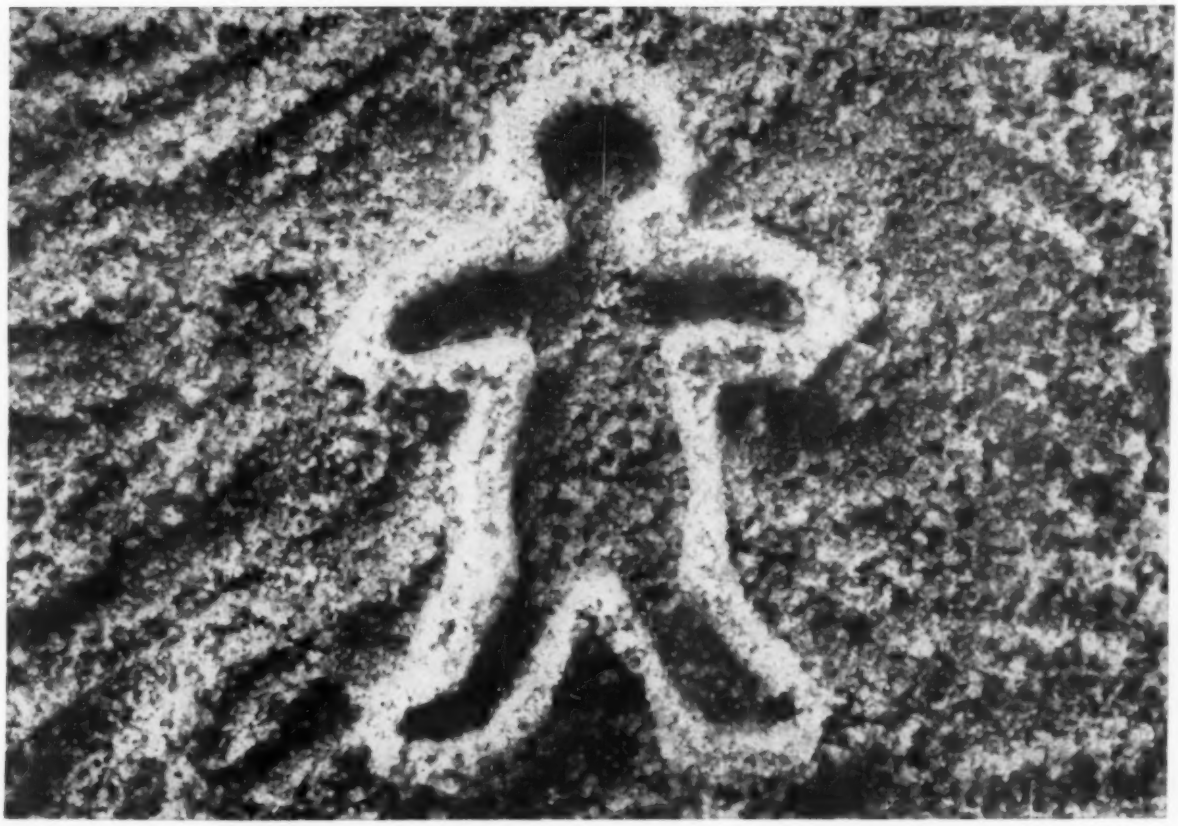

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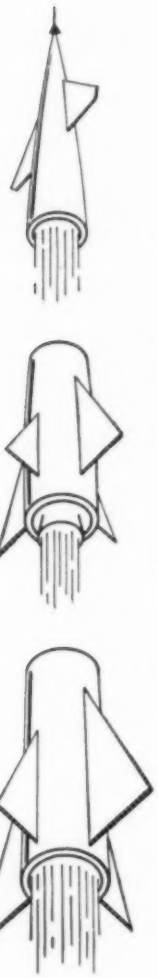

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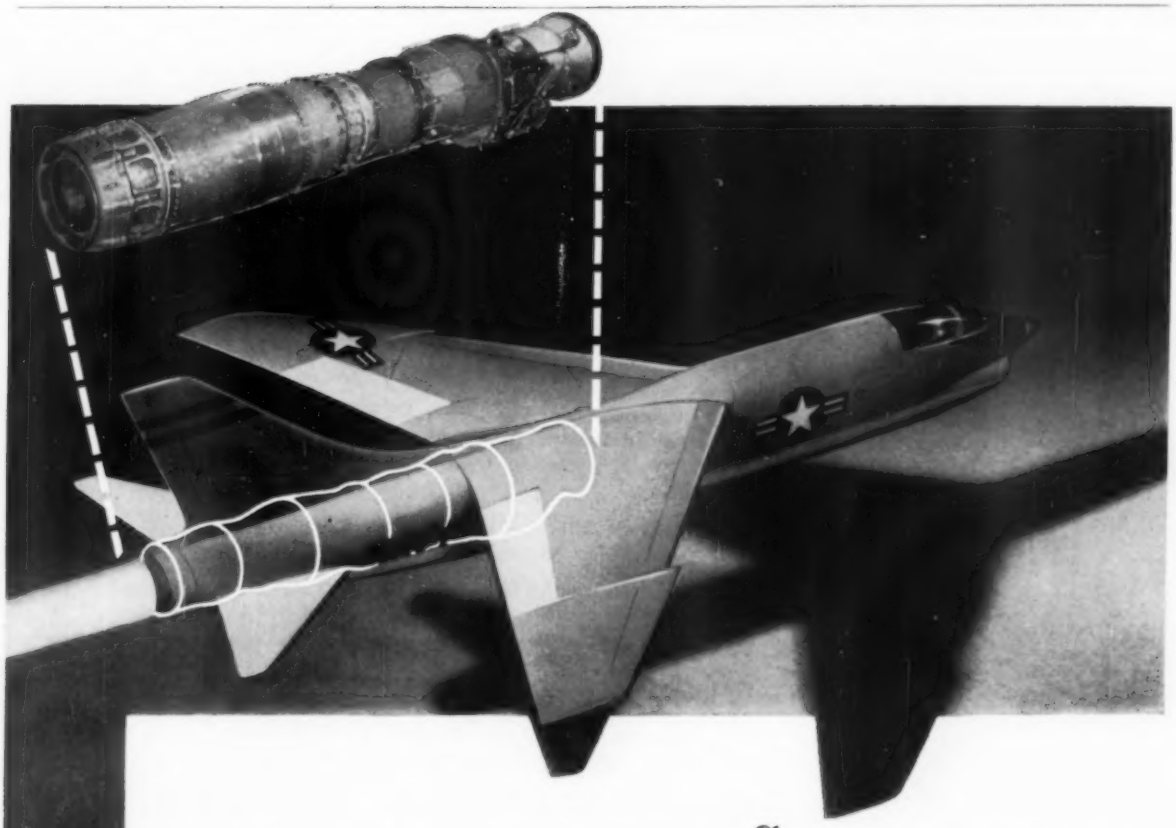

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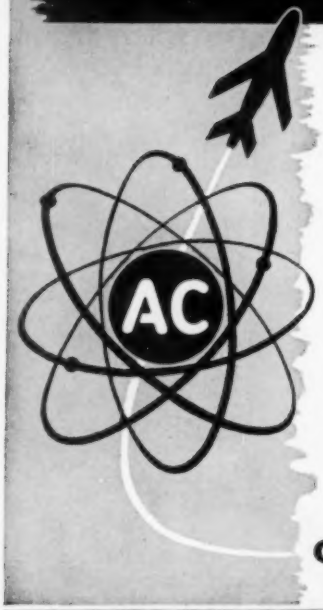

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P-9514, Aviation Week
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LETTERS

Why No Technicians

Please renew my subscription to AVIATION WEEK. I must apologize for letting it drop as I did, laboring under the assumption that your magazine was doing little to alleviate a situation which has now become a national problem of great and critical size. I refer to the lack of technicians, engineers and scientists, and the fact that Russia is winning this technological race hands down.

My business is Industrial Education. I teach on both the secondary and adult levels. I have taught in high school, college and university classes in both teacher-training and technician-training courses.

Alternately I work in the field of education and as a tool designer, machine designer, metallurgical or process engineer. In my last excursion into industry I worked as a process engineer on jet turbine blades. In my present work I am training electronic technicians on the senior high school level and giving three hours per week to a group of tool designers and production engineers in a course entitled, "Basic Electronics and Automation." I am an aviation ground instructor, with all ratings; also a BSc. with a major in industrial science and minors in aviation and English.

Technological Thirst

As I see the problem we, as an industrial nation, are suffering from a technological thirst of great magnitude and the stream from which we should be able to assuage this thirst has been reduced, relatively, to a mere trickle. I am referring to the lack of students and courses in science and mathematics in our secondary schools.

In this particular locality I conduct high school classes in Applied Electronics for the 11th and 12th grades, with fair facilities and financial encouragement from local, state and federal governments under the Smith-Hughes' law. From a total high school population of approximately 6,000 students, I find 15 interested in electrical training. Of these only half possess the necessary background of mathematics to enable them to comprehend the meaning of Ohm's Law.

According to a recent article in your magazine we are running short of pilots. Following the last war many would-be commercial pilots sat in my classes on navigation and meteorology. Many were badly discouraged and finally quit because a lack of high school physics and mathematics made it impossible for them to figure the most simple problems in dead reckoning or use an E6B computer, etc.

Educational Breakdown

This problem of technological starvation has its roots deep in our primary and secondary schools. It has possible solutions, the description of which would take more than a letter to outline. The present level of techers' salaries is one aspect of the situation. To illustrate this I will give an example.—

Recently a national firm, which is advertising for technicians (electronic) in many magazines of both the popular and technical type, made a local bid for "technician-learners". Of sixty applicants, mainly high school graduates and boys in the 12th grade of high school, only two could pass the written and oral examination necessary for qualification.

This examination pre-supposes a knowledge of physics, mathematics (elementary algebra and trigonometry), drafting (simple mechanical and electrical) and basic electronics.

Few high schools give this combination. During the interview, however, a significant fact came to light. The firm was offering to successful applicants, as a beginning salary with "fringe benefits" during their training period, more per month than we pay a beginning teacher in high school with a college degree!!!!

HARRY R. WILSON, Instructor
Applied Electronics
Trade and Industrial Education
Adult Education Center
419 North Capitol Ave.
Lansing, Mich.

P. S. Your editorial and report of speeches by Dr. Killian and David Sarnoff should be required reading in all secondary schools and colleges in this country. I refer to your January 30th issue.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Aboard a KB-29

I would like to add my two-bits to those of USAF pilot (name withheld). I am a graduate aeronautical engineer, ex-ROTC and rated pilot.

My entire tour of duty (three years after wings) has been and will be as a co-pilot on KB-29s. Make no mistake, the B-29 was a grand old bird, but in this day and age, it is rapidly approaching a bucket of bolts stage. Practically every flight is conducted in a state of semi-emergency—everything from operating turbo-superchargers manually to one or more engines out. From two years experience, I can count on losing an engine every 50 flight hours.

Our navigation equipment consists of an automatic radio compass, a low frequency receiver and a not too reliable radar, (omitting celestial meanderings—which are useless in IFR). The average Cessna 170 or Bonanza is better equipped than one of SAC's finest. Above all, I have to read in your magazine of such niceties as Omni, Tacan, Zero Readers, Nafli, ILS, etc.

We are improving, however. Last November we got two bright, shiny new windshield wipers. So, with the above listed array, we wander about the states and overseas, and may I hereby apologize to the CAA, airline pilots and other users of the oftentimes misty blue—please you guys, we're not lost because we're overly unintelligent; it's because we're on an IFR direct (off airways—but cross 'em here and there) navigational training flight, we're in the soup, the navigator can't see the stars, the birddog's out, the radar set caught fire, we've been flying manually for nine hours and we haven't had time to locate ourselves with the spin-the-dial routine on the low-frequency receiver. I would also like to apologize for gumming up the communication facilities with garbled transmissions over obsolete throat mikes.

Outside of the above use of my $50,000 training for 400 hours in the great silver pickle (two yrs.), my engineering training was put to great use as officer-in-charge of a tool crib, where I counted screwdrivers and wrenches as I had done in high school to earn money for 30 minutes in a Piper Cub.

Biased as I may be, it would seem economical to either have flown me "whole hog" or in a combination fly and engineering job at Eglin, Holloman, Wright, or Edwards AFB. To my would-be detractors, I have in my file six refused transfer applications (from ARDC to B-47s and T-6s), and my officer effectiveness reports are on file in the Pentagon (with prior permission). I am not bitter but am rather proud to have served by country for four years. I am, however, disgusted at my utilization in this day of scarce pilots and still "scarcer" engineers.

DISGUSTED USAF PILOT (name withheld)

Propeller Weight

While we are writing you, we thought we might bring one minor misstatement to your attention. On page 62 (in an article on new forming techniques developed by A. O. Smith Corp.), under "Experimental Propeller Blades" (AVIATION WEEK, January 30, 1956) the second sentence should have read —the blades weigh one-third "less" in titanium alloy, rather than one-third as much. We thought we would just make this correction in case any of your readers inquire about this.

F. A. GRUETJEN
Director of Aeronautical Development
A. O. Smith Corp.
Milwaukee 1, Wis.

Aleutian Airports

In reading the January 2 issue of AVIATION WEEK I noted that in the article on page 60 it was stated that Northwest Airlines by operating Shemya was the first American carrier to operate their own airport.

I would like to point out that Bob Reeve has been operating two airports for a number of years in this same part of the world. Reeve Aleutian Airways is a U. S. certificated carrier and they operate the airports at Port Heiden and Umnak in the Aleutians, as well as their own communication and navigational equipment over a mighty rough route.

JOSEPH H. WAGGONER, Chief Advisor
United States Department of Commerce
Civil Aeronautics Administration
International Field Office
Manila, Philippines

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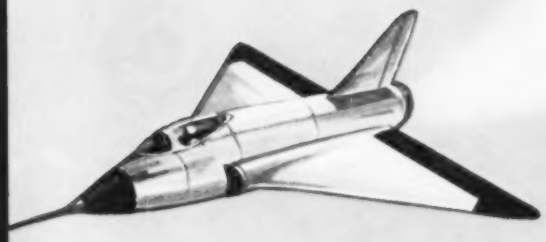

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